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THE UNIVERSITY OF ALBERTA

AN EXPLORATORY STUDY OF INFERENCE, AND COGNITIVE SYNTHESIS IN READING COMPREHENSION WITH SELECTED GRADE FOUR READERS

by

Ⓒ

RODERICK WILLIAM McLEOD

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "An Exploratory Study of Inference, and Cognitive Synthesis in Reading Comprehension with Selected Grade 4 Readers," submitted by Roderick William McLeod in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

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Date December 5, 1977

ABSTRACT

This exploratory study investigated the role of inference in discourse reading comprehension. The major purposes were to explore the generation of forward-looking and backward-looking inferences (Schank, 1975), and examine whether inference generation is related to successive and simultaneous cognitive synthesis (Luria, 1966a). Emphasis placed on the two types of inference in selected reading materials was examined also. The reader who is proficient in vocabulary development, but less proficient in reading comprehension was the focus of this investigation.

Forty grade four subjects from five suburban schools in the Edmonton Public School System participated in this study. These subjects were classified as Very Proficient (n=20) or Less Proficient (n=20) readers from scores on vocabulary and comprehension subtests of the Stanford Reading Achievement Test (1964). To evaluate and classify these subjects on successive and simultaneous synthesis, two tests were selected and administered from the Das Cognitive Synthesis Battery (1975). These were Visual Short Term Memory Test (successive synthesis) and Memory for Design Test (simultaneous synthesis).

Each subject completed three reading-related inference tasks in individual introspective-retrospective interview sessions. These tasks, which were developed and administered by the investigator, consisted of: (1) The Oral-Reading Inference Task (ORIT), (2) The Story-Recall Inference Task (SRIT), and (3) The Directional-Question Inference Task (DQIT). Initially these interviews were tape-recorded, and later transcribed into typed protocols.

These protocols were analyzed qualitatively using content analysis systems developed by the investigator. Independent coefficients of agreement (Loban, 1949; Squire, 1964) were generally above .90 and did not drop below .80. Where feasible, qualitative data were quantified and submitted to statistical analyses to test the hypotheses generated. Statistical tests included chi square, sign tests, independent t-tests, and two way analysis of variance.

Both forward and backward-looking inferences were identified in the prepared questions designed for selected commercial reading materials. Forward-looking inferences received greater emphasis.

Reading proficiency was revealed to be significantly related to simultaneous synthesis ($p=.00$), but not successive synthesis ($p=.88$).

On ORIT and SRIT all subjects generated significantly more supported than non-supported backward-looking inferences ($p=.04$). Only the Very Proficient Readers generated more supported than non-supported forward looking inferences ($p=.00$).

On the DQIT data, forward-looking inferences were related significantly to simultaneous synthesis ($p=.03$). Subjects ranked high on simultaneous synthesis achieved higher mean performance scores. Backward-looking inferences were related significantly to successive synthesis ($p=.05$). The subjects ranked low on successive synthesis demonstrated superior mean performances. On acceptability of inferential responses ($p=.04$), provision of textual support ($p=.00$), and verbalized linking of textual support to inferential responses ($p=.00$), Very Proficient Readers were significantly superior.

Some of the major conclusions were: (1) grade four students are required to generate both forward and backward-looking inferences in prepared instructional activities, (2) forward and backward-looking inferences make different cognitive demands on the maturing reader, (3) inference generation is related to cognitive synthesis; however, (4) other cognitive strategies, such as selecting appropriate supporting textual information, and linking the inference back into the story context to confirm that it "makes sense", also significantly differentiated the Less Proficient from the Very Proficient Reader.

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CHAPTER 1

INTRODUCTION AND STATEMENT OF THE PROBLEM

Current literature in the field of reading reflects an increasing interest in comprehension as the focus and basic purpose of the reading processes (Smith, 1975). However, "comprehension" is an elusive term which has appeared in the reading literature only since the 1920's (Smith, 1965; Cleland, 1965). In the decades since, the term has been used indiscriminately by writers in the field of reading (Kerfoot, 1965) to refer to both a specific (e.g. Gray, 1960; Carroll, 1972) and to global (e.g. Kingston, 1961; Smith & Barrett, 1974) aspects of understanding written language. Smith (1965, p.117) has described the word as "an omnibus term which has stood in the way of developing true depth in reading". Recognizing this problem, Carroll (1972) attempted to define "pure comprehension", and in so doing, associated two closely related accompanying processes which he identified as "memory" and "inference". While Carroll has admitted that it is probably not possible with our present state of knowledge, to separate successfully these three interrelated factors, he has called for greater awareness of the role each plays in efficient understanding of human verbal language. The present study has been designed to explore the role of inferencing in reading comprehension.

Factor analytic research by Feder (1938), Davis (1944, 1968), Pettit (1970), and Pettit and Cockriel (1974) has indicated consistently two identifiably discrete factors in their analyses of reading comprehension. These have been identified traditionally as literal comprehension, or the understanding of explicitly stated information provided by the writer, and inferential comprehension, or the understanding of inferred information not specifically stated but assumed by the writer and which must be supplied by the reader. Although other factors have been identified also by some of the above studies, these two factors have emerged in all the studies cited.

Interest in the role of inference in the understanding of various aspects of verbal language comprehension has emerged recently in the two language-related fields of psycholinguistics and natural language information processing. In the former area, researchers have recently extended their studies beyond the sentence level to the discourse level, and the latter have attempted to explain how episodes, larger than the sentence, are represented in memory. Both trends in recent research have brought inference to the fore.

The theoretical work by Schank (1975) in the area of natural language information processing was of particular interest in the present study. Schank has stated that inference is a vital factor in the understanding and memory processes. He has distinguished inference into two types which he has identified as forward-looking inferences and backward-looking inferences. For definitions of these terms refer to the section on definitions in this chapter. Schank's theory appears to be somewhat similar to the earlier work of Bartlett (1951) who described thinking in terms of two systems - open and closed. Both men have been concerned with the cognitive structure of meaning representation. Schank has posited that inferences serve one of two purposes, (1) to fill in empty slots to make the meaning structure comprehensible, or (2) to tie together conceptualizations to enhance understanding. Within his closed system, Barlett has described interpolation and extrapolation as "gap filling processes" of thinking. Schank's concept of inference appears to be related, at least in part, to Bartlett's interpolation and extrapolation.

If Bartlett's closed and open systems are viewed as opposite ends of the thinking continuum, then reading would appear to span both systems depending upon the reader's purpose. If he is reading to understand the author's intended message, the processes would appear more related to Bartlett's closed system in that reading to understand involves "a limited number of units (ideas) or items, or members, and those properties of the members which are to be used are known to begin with and do not change as the thinking proceeds". (Bartlett, 1951, p.23). On the other hand, reading that has evaluative, appreciative, or creative goals could appear to be of a more open nature. In the present study, the focus was on the understanding aspect of reading. In a discussion of Bartlett's theory and its implications for reading, Jenkinson (1961) has identified three types of structures which are utilized by the reader and in turn shape his cognitive meaning representation. These are (1) language structure, (2) the thinking-reading process structure, and (3) the content structure of the material to be read. In this study the major focus was on the structure composed by the thinking-reading processes. However, this could not be explored without the influence of the first, and in fact the third type of structure. So to some degree, all three types of structure are considered in this investigation.

Much of the work in the fields of psycholinguistics and natural language information processing has been carried out using oral language stimuli. Only limited attention has been given to the understanding of human verbal written language. Although the ability to draw inferences is discussed in general descriptions of comprehension, and exercises are included in student reading materials which require the drawing of inferences, very limited research is available presently on the cognitive strategies used by maturing readers when required to draw inferences. In particular, little attention has been given to those readers who have adequate vocabulary development but lack proficiency in comprehension. Such subjects have been identified in a recent study of cognitive synthesis in reading comprehension of adults (Latham, 1973). If such readers existed in the adult reading population, it appeared expedient, as a first step, to identify and explore how such readers in earlier developmental stages of reading process printed information in order to draw inferences. In this way, direction for research into instructional strategies which could enhance proficiency in comprehension may be provided. Therefore the present study has focused on the cognitive strategies used by the afore described readers at a grade four level when required to draw inferences when reading selections of continuous narrative discourse.

In the remaining sections of this chapter, the major purposes of the study will be identified, important terms defined, assumptions stated, research questions posed, and limitations of the study considered.

STATEMENT OF PURPOSE

This study was designed with four major purposes in view. The first purpose was to investigate how selected fourth grade children, who had been designated as very proficient readers and less proficient readers on the basis of achievement on the subtests of vocabulary and comprehension of a standardized reading test, generate inferences when reading narrative discourse. More specifically, the study explored whether differences exist in the generating of two kinds of inferences which had been identified by Schank (1975) as forward-looking and backward-looking.

The second purpose was to attempt to relate the generation of inferences to the cognitive processing of the selected subjects. In particular, the role of cognitive synthesis was explored in terms of two types of information integration first described by Luria (1966a, 1966b) as simultaneous and successive synthesis, and more recently operationalized and defined by Das and his associates (1975) as spatial information integration, and temporal information integration, respectively.

Thirdly, this study was designed to provide insights into the comprehension strategies of a specific type of reader, namely the subject who is proficient in vocabulary but not proficient in terms of comprehension (Latham, 1973).

Finally, the study has provided information about the emphasis placed on the two types of inferencing in selected reading materials recommended in the Province of Alberta.

DEFINITIONS

For the purpose of this study, the following definitions are employed:

Reading comprehension - a complex of processes (Geyer and Kolers, 1974) involved in bringing meaning to the printed page (Cleland, 1965) and interacting with that written message in order to communicate with the author (Kingston, 1961).

Written discourse - the graphic representation of English verbal language (Robertson, 1966; Cosens, 1974) presented in printed strings of interconnected sentences (Carroll and Freedle, 1972) in a multi-paragraph format (Rumelhart, 1975) composing a story of about 300-500 words.

Very proficient reader - a subject who has attained a vocabulary score and a comprehension score on the Stanford Reading Achievement Test (1964), both of which are above the 85th percentile (Laing, 1974).

Less proficient reader - a subject who has attained a vocabulary score above the 70th percentile, and whose comprehension score is at or below the 55th percentile score on the Stanford Reading Achievement Test (1964).

Inference - cognitively generated information based on explicit linguistic and non-linguistic information provided in the context of continuous written discourse, and which was previously unstated.

Forward-looking inference - inferences "which are inferable from input conceptualizations" (Schank, 1975, p.245). These inferences tie together two or more conceptualizations to produce higher level structures.

Backward-looking inference - inferences "that must be generated [by the reader] for each input conceptualization" (Schank, 1975, p.245). These inferences fill in gaps between explicitly stated conceptualizations, and cause or enable the following explicitly stated information to "make sense".

Cognitive synthesis - the cognitive processes by which the human brain integrates incoming sensory information into meaningful cognitive representations. (Luria, 1966a, 1966b, 1970). These same processes have been defined as information integration (Das, Kirby, & Jarman, 1975). These integrative processes are of two general kinds, simultaneous (Luria, 1966a) or spatial information integration (Das, Kirby, & Jarman, 1975), and successive (Luria, 1966a) or temporal information integration (Das, Kirby, & Jarman, 1975). These two integrative processes may be involved at a sensory, memory, or intellectual level.

Simultaneous synthesis - one type of cognitive processing that integrates incoming sensory information into groups which are primarily spatial in nature (Luria, 1966a). This integrative activity has also been identified as spatial information integration (Das, Kirby, & Jarman, 1975).

Successive synthesis - a second type of cognitive processing that integrates incoming sensory information into serial orders (Luria, 1966a). This serial system is never totally surveyable at any one point in time. This integrative activity has been identified as temporal information integration (Das, Kirby, & Jarman, 1975).

Cognitive synthesis groups - four groups of students created on the basis of ranked performances on the successive synthesis test, and the simultaneous synthesis test. A median split was performed on each set of ranked scores to identify the four groups. These are described below.

High Simultaneous - High Successive group - those subjects who ranked high (above the median) on both the successive synthesis test and the simultaneous synthesis test.

High Successive - Low Simultaneous group - those subjects who ranked high (above the median) on the successive synthesis test, but low (below the median) on the simultaneous synthesis test.

Low Successive - High Simultaneous - those subjects who ranked low (below the median) on the successive synthesis test, but high (above the median) on the simultaneous synthesis test.

Low Successive - Low Simultaneous group - those subjects who ranked low (below the median) on both the successive synthesis test and the simultaneous synthesis test.

ASSUMPTIONS

The present study has been based on the following assumptions:

(1) the maturing reader can be viewed as a human information processor who selects, codes, stores, retrieves, and manipulates information from the reading material and his own cognitive-structure-of-the-world in order to make sense out of the stimulus input. This "making sense" involves four major sets of strategies which have been identified as selection, generation, confirmation and correction;

(2) the cognitive synthesis tasks and the inferencing tasks assess underlying cognitive processes;

(3) the overt verbal responses of the subject are indicative of his covert cognitive processes;

(4) by comparing the subject's introspective-retrospective verbal responses with the stimulus input, insights will be provided into the intervening cognitive processes used by selected maturing readers to draw inferences from written narrative discourse.

RESEARCH QUESTIONS AND HYPOTHESES

The following research questions and null hypotheses were generated within the framework of the present study.

Research Question 1. Are there significant differences between the Very Proficient Readers and the Less Proficient Readers, as defined in this study, in terms of the two types of cognitive synthesis identified by Luria (1966a) as successive synthesis and simultaneous synthesis?

H1.1 There is no significant difference between the scores of the Very Proficient Readers and the Less Proficient Readers on the test of successive synthesis.

H1.2 There is no significant difference between the scores of the Very Proficient Readers and the Less Proficient Readers on the test of simultaneous synthesis.

Research Question 2. Are there significant differences between the boys and girls observed in this study in terms of the two types of cognitive synthesis, successive and simultaneous?

H2.1 There is no significant difference between the scores obtained by the boys and by the girls on the test of successive synthesis.

H2.2 There is no significant difference between the scores obtained by the boys and by the girls on the test of simultaneous synthesis.

Research Question 3. Are there significant differences among the four cognitive synthesis groups, as defined for this investigation, in terms of the four criteria variables of non-verbal IQ, chronological age, reading vocabulary, and reading comprehension?

H3.1 There are no significant differences among the four cognitive synthesis groups in terms of:

.11 Non-verbal IQ scores

.12 Chronological age in months

.13 Reading vocabulary percentile scores

.14 Reading comprehension percentile scores.

Research Question 4. Are there significant differences among the four cognitive synthesis groups in terms of the quantity of forward and backward looking inferences generated, and the quality of inferences generated in a self structured reading situation?

H4.1 There are no significant differences among the four cognitive synthesis groups in terms of the number of inferences generated that are:

.11 forward-looking in nature

.12 backward-looking in nature.

H4.2 There are no significant differences among the four cognitive synthesis groups in terms of the number of supported inferences generated.

Research Question 5. Are there significant differences within each of the four cognitive synthesis groups in terms of the quantity and quality of the inferences generated in a self structured reading situation?

H5.1 There are no significant differences within the High Successive High Simultaneous group in terms of:

.11 the quantity of forward and backward looking inferences

.12 the number of supported forward-looking inferences

.13 the number of supported backward-looking inferences.

H5.2 There are no significant differences within the High Successive - Low Simultaneous group in terms of:

.21 the quantity of forward and backward-looking inferences

.22 the number of supported forward-looking inferences

.23 the number of supported backward-looking inferences.

H5.3 There are no significant differences within the Low Successive - High Simultaneous group in terms of:

.31 the quantity of forward and backward-looking inferences

.32 the number of supported forward-looking inferences

.33 the number of supported backward-looking inferences.

H5.4 There are no significant differences within the Low Successive - Low Simultaneous group in terms of:

.41 the quantity of forward and backward-looking inferences

.42 the number of supported forward-looking inferences

.43 the number of supported backward-looking inferences.

Research Question 6. Are there significant differences among the four cognitive synthesis groups in terms of (1) the kind of inference, (2) the acceptability of the inferential responses, (3) the use of textual support for the responses, and (4) the verbalized linking of the support to the inferential response in a question-structured situation?

H6.1 There are no significant differences among the four cognitive synthesis groups in a question-structured situation in terms of:

.11 the scores for forward-looking inferences

.12 the scores for backward-looking inferences

.13 the scores for acceptable inferential responses

.14 the scores for textual support of the inferences

.15 the scores for verbalized linking of textual support to inferential response.

Research Question 7. Are there differences among the four cognitive synthesis groups in terms of (1) reader interaction with the text, (2) kind of textual information used to generate inferences, and (3) proficiency in story recall?

H7.1 There are no significant differences among the four cognitive synthesis groups in terms of:

.11 the total number of verbalized interactions with the text

.12 the number of inferential verbalizations and translation verbalizations.

H7.2 There are no significant differences among the four cognitive synthesis groups in terms of the number of inferential responses identified as:

.21 word based

.22 sentence based

.23 beyond sentence based.

H7.3 There is no significant difference among the four cognitive synthesis groups in terms of the number of story units identified in the story recall protocols.

Research Question 8. Are there significant differences between the Very Proficient and Less Proficient Readers in terms of the quantity of forward and backward-looking inferences generated, and the quality of the inferences generated in self structured reading situations?

H8.1 There is no significant difference between the Very Proficient and Less Proficient Readers in terms of the number of inferences generated that are:

.11 forward-looking in nature

.12 backward-looking in nature.

H8.2 There is no significant difference between the Very Proficient and Less Proficient Readers in terms of the number of supported inferences generated.

Research Question 9. Are there significant differences within the Very Proficient and Less Proficient groups of readers in terms of the quantity and quality of the inferences generated in self structured reading situations?

H9.1 There is no significant difference within the Very Proficient group of Readers in terms of:

.11 the quantity of forward and backward-looking inferences

.12 the number of supported forward-looking inferences

.13 the number of supported backward-looking inferences.

H9.2 There is no significant difference within the Less Proficient group of Readers in terms of:

.21 the quantity of forward and backward-looking inferences

.22 the number of supported forward-looking inferences

.23 the number of supported backward-looking inferences.

Research Question 10. Are there significant differences between the

Very Proficient and Less Proficient Readers in terms of (1) the kind of inference, (2) the acceptability of the inferential responses, (3) the use of textual support for the responses, and (4) the verbalized linking of the support to the inferential responses in a question structured situation?

H10.1 There is no significant difference between the Very Proficient Readers and the Less Proficient Readers in a question structured situation in terms of:

.11 the scores for forward-looking inferences

.12 the scores for backward-looking inferences

.13 the scores for acceptable inferential responses

.14 the scores for textual support of the inferences

.15 the scores for verbalized linking of the textual support to the inferential responses.

Research Question 11. Are there significant differences between the Very Proficient and Less Proficient groups of readers in terms of (1) reader interaction with the text, (2) the kind of textual information used to generate inferences, and (3) proficiency in story recall?

H11.1 There is no significant difference between the Very Proficient and Less Proficient groups of Readers in terms of:

.11 the total number of verbalized interactions with the text on ORIT

.12 the number of inferential verbalizations and the number of translation verbalizations on ORIT.

H11.2 There is no significant difference between the Very Proficient and Less Proficient groups of Readers in terms of the number of inferential responses identified as:

.21 word based

.22 sentence based

.23 beyond sentence based.

H11.3 There is no significant difference between the Very Proficient and Less Proficient groups of Readers in terms of the number of story units identified in the story recall protocols.

Where appropriate the above hypotheses were submitted to statistical analyses. When the data generated were not amenable to statistical procedures, descriptive techniques such as percentages were used to explore the research question posed.

LIMITATIONS OF THE STUDY

The limitations of the present study are given below:

1. The study will consider only one aspect of inferencing (forward-looking vs. backward-looking) with two selected groups of grade four readers (very proficient vs. less proficient). These subjects cannot be said to be representative of grade four readers in general. However, the findings may be applicable to those students who have the characteristics of the subjects selected for the experimental groups.
2. The cognitive information integration processes explored in this study have been limited to selected tasks from the Das Cognitive Synthesis Battery.
3. Introspective reading and retrospective recall are clinical techniques and cannot be said to be representative of "normal" reading.

4. The verbal responses and recalled experiences of reasoning while reading cannot be said to be identical with the actual cognitive processes. However, they do provide insight into the cognitive activities of which the subject is aware.
5. Each subject used only one stimilus discourse selection for all three reading-related inference tasks. This could potentially confound the results with a learning effect. However, the procedure was neccessary to make the comparisons required to answer some of the research questions. Furthermore, it was felt that the use of different tasks based on the same reading selection reflected more closely actual classroom practise. As well, the distinctive nature of the tasks (self-structured vs. question-structured; introspective vs. retrospective) was felt to mitigate any learning effect.

SIGNIFICANCE OF THE STUDY

It has been recognized generally that there are students at all levels of reading development who are proficient in word recognition and identification abilities, but who lack proficiency in comprehension. Recent research in language-related areas of study has indicated the importance of the role of inference in developing understanding of human verbal messages. The present study would appear to be the first attempt to explore how selected maturing readers generate inferences when reading continuous discourse. Therefore, the findings of the present study may provide useful insights into the inferencing aspects of the comprehending strategies of those specific readers identified at the outset of this paragraph.

In addition this study was the first known attempt to verify the

the psychological reality of the distinction between forward and backward-looking inferences with maturing human information processors. The findings have provided a basis for accepting this theoretical distinction for maturing readers. Furthermore, this was the first known study to attempt to link specifically the spatial and temporal aspects of cognitive information integration processes with the two kinds of inferencing (forward and backward-looking). Insights have been provided regarding their relationships within the framework of reading comprehension

The study is not intended to provide information which can be translated directly into classroom practices. However, the findings have proven useful in clarifying theoretical aspects of inferencing which have been identified by Ruddell as an important factor in the integrative skills required in reading comprehension. Thus, the study has implications for theory development, and has provided direction for further research of both a theoretical and instructional nature into the generating of inferences when reading continuous narrative written discourse.

ORGANIZATION OF THE DISSERTATION

Chapter 1 has been devoted to the introduction and statement of the problem. The research questions that guided the study have been stated. Important terms have been defined. Assumptions, and limitations of the study have been given, and the significance of the study discussed.

In Chapter 2, a review of related literature and research is presented from which the theoretical framework of the present study evolved.

Methods of investigation and research procedures are detailed in Chapter 3. Discussions of the design, subjects in the sample, instrumentation and data collection procedures, and the treatment of the data are included in this chapter.

In Chapter 4, the instruments used in the reading-related inference tasks are described, and their development by the investigator detailed.

The findings of the qualitative and quantitative analyses of the subjects' performances on the cognitive synthesis tests are presented and discussed in Chapter 5.

In Chapter 6, the procedures followed in the qualitative and quantitative analyses of the reading-related inference tasks are described. The findings of these anlayses are presented and discussed.

The theoretical implications of the findings presented in the previous chapters are discussed, and modifications are suggested for the Ruddell, and Das theoretical models in Chapter 7.

A summary of the study, the conclusions, implication, and suggestions for further research have been presented in Chapter 8.

CHAPTER 2

BACKGROUND TO THE STUDY

One of the trends during the sixties and the early seventies has been a prolific production of theoretical models of the reading act. A survey of the available models reveals that few have given much attention to comprehension. Most model builders have emphasized recoding and decoding processes.

One of the more comprehensive models which does attempt to represent comprehension has been developed by Ruddell (1969), and more recently modified (Ruddell and Bacon, 1972; Ruddell, 1974). In the latest revision of the model (see Figure 2.1) comprehension has been viewed as being comprised of two major aspects, namely "Aspects of Meaning", and "Interpretation". The major focus of the present study is within the aspect of comprehension identified by Ruddell as "Interpretation", although some consideration will be given to the "Aspects of Meaning".

The aspect of "Interpretation" has been sub-divided into (1) semantic interpretation, (2) memory store, and (3) feedback systems. Within the semantic interpretation component, Ruddell (1974) has identified three levels of processing. These are (1) factual, (2) interpretative, and (3) applicative. While the first focuses on the identification and recall of information specifically represented in the text, the second encompasses analytic, integrative, and evaluative processes.

The third level deals primarily with the use of textual information to solve problems. The present study has focused on one sub-

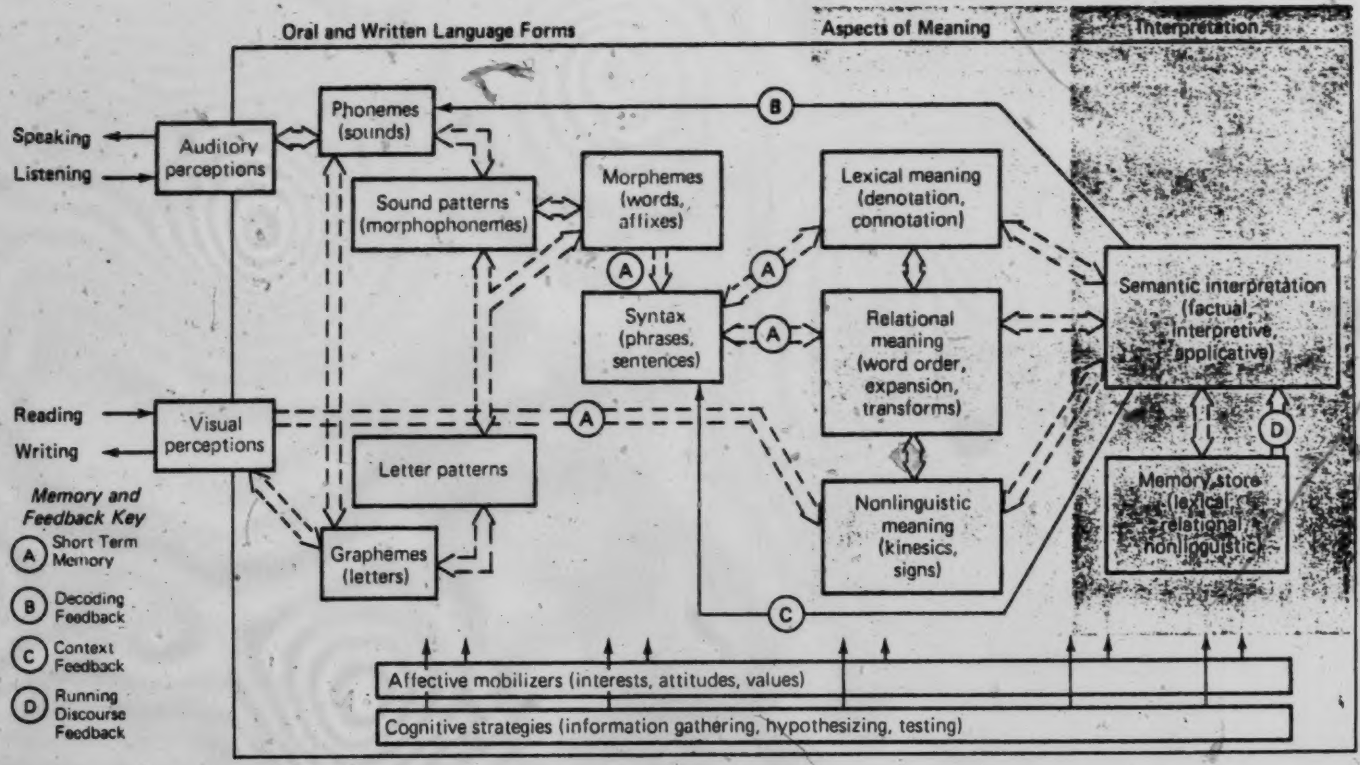

Oral and Written Language Forms
Aspects of Meaning
Interpretation
Speaking
Listening
Reading
Writing
Auditory perceptions
Visual perceptions
Phonemes (sounds)
Sound patterns (morphophonemes)
Letter patterns
Graphemes (letters)
Morphemes (words, affixes)
Syntax (phrases, sentences)
Lexical meaning (denotation, connotation)
Relational meaning (word order, expansion, transforms)
Nonlinguistic meaning (kinesics, signs)
Semantic interpretation (factual, interpretive, applicative)
Memory store (lexical, relational, nonlinguistic)
A
B
C
D
Affective mobilizers (interests, attitudes, values)
Cognitive strategies (information gathering, hypothesizing, testing)
Memory and Feedback Key
A Short Term Memory
B Decoding Feedback
C Context Feedback
D Running Discourse Feedback

Figure 2.1 RUDDELL'S (1974) COMMUNICATION'S FRAMEWORK

component of the integrative processes at the interpretive level, namely "inferring beyond given data" (Ruddell and Bacon, 1972).

Although Ruddell has discussed interpretation as one level of processing in comprehension, the actual cognitive processes involved have been described in quite global terms. The major emphasis of the model appears to be on the input information and the output products. Thus, this study has been designed to attempt to explore the intervening process dimension of inference as an important facet of "integrative thinking" at the "interpretive level" within "semantic interpretation" of the information components in "aspects of meaning".

In this chapter, selected literature and research will be reviewed and synthesized within Ruddell's (1974) "Communications framework". To provide the background for the present study, support will be drawn from the areas of reading research, psycholinguistic theory and research, information processing theory and research, and neuropsychology. The latter three areas will be related to either "Aspects of Meaning" or "Aspects of Interpretation" in Ruddell's model.

INFERENCE AND DISCOURSE COMPREHENSION

This section presents the views of reading experts and previous research relative to inference, and the discourse level of comprehension.

Expert Opinion and Research on Inference

Previous reading research into inferencing has been product oriented and has shed little light on the cognitive processes involved. Factor analytic studies by Feder (1938), Davis (1968, 1944), Pettit (1970) and Pettie and Cockriel (1974) have identified the ability to make inferences when reading as a discrete and essential factor in successful reading comprehension. However, it should be noted that this conclusion does not have universal acceptance. Thurstone (1946) on a reanalysis of the Davis data (1944) concluded there was only one major underlying factor. In a similar manner, Thorndike (1973) reanalyzed the 1968 Davis data and reached the same conclusion. Thorndike (1973) identified this underlying factor as "verbal reasoning" while Thurstone (1946) called it "reading ability". While these viewpoints have been quoted as conflicting conclusions, in essence they may not be. If one views reading comprehension as "the reduction of uncertainty" (Smith, 1971) through the relating of information, one becomes aware that two essential kinds of information are required for successful reading comprehension.

By way of illustration, consider the kinds of information that the reader is required to integrate as he reads this chapter. One source of information exists in the writer's brain and has been represented by the little black marks arranged systematically across the page from left to right, and top to bottom. The other source of information exists in the reader's brain, and is the product of all his past experiences, real and vicarious. It is the reader's "cognitive-structure-of-the-world". In the reading act, as mentioned above, the ideas from the writer's brain have been represented by the ink marks on the page, and as such this source of information has become overt; the cognitive structure held by the reader in his brain is covert, and is not readily observable. Smith (1975, 1971) has identified these two different kinds of information as "visual" and "nonvisual" respectively. While the first establishes the parameters of the communication, the latter is also clearly essential to interpretation. In a written communication it could become extremely tedious if the author had to always "tell all". Therefore, he often assumes certain basic information is common to the reader, and does not state it. Understanding what has been explicitly stated has been termed traditionally "literal comprehension", while understanding the unstated and assumed has been referred to as "inferential comprehension" (Smith and Barrett, 1974). Efficient comprehension appears to rest on the successful integration of both. This integrative process would seem to be what Thurstone (1946) and Thorndike (1973) have identified, while the studies of Feder (1938), Davis (1944, 1968), Pettit (1970) and Pettit and Cockriel (1974) have identified the underlying processes in terms of the kind of information being integrated. Thus, the apparent disagreement of the two findings may indeed be the result of differing perspectives.

As well as the factor analytic studies, other research has given support for the psychological reality of inferencing. During the fifties at the University of Chicago, a number of doctoral dissertations (Swain, 1953, Piekarz, 1954; Jenkinson, 1957; Letton, 1958) were designed using introspective-retrospective interview techniques to explore the processes utilized by subjects in various reading tasks that entailed comprehension. Swain (1953), working with college freshmen, concluded that "language analysis", and "meaning structure" were two variables that differentiated good and poor readers. Piekarz (1954) studied sixth grade students in order to explore the process of interpretation in reading. She found that lower level readers tended to process at a literal, surface level of meaning, and gave little attention to implicit information, and little or no attention to critical evaluation. As well, these readers encountered difficulty in differentiating between the author's ideas and their own ideas, and often strayed far beyond the limits of the author's intended meaning. On the other hand, higher level readers were generally more objective, and could view the selection more impersonally. They brought to bear their experiential background but remained within the limits sets by the author. Their own experiences were primarily mentioned to prove a point. Jenkinson (1957) studied subjects in grades ten, eleven and twelve in her study of selected processes and difficulties related to reading comprehension. She utilized the cloze procedure as well as introspective-retrospective techniques. From her analyses of the introspective-retrospective protocols she developed a three dimension framework from which she then viewed reading comprehension. The major components of this framework were (1) "Language Structure", (2) "Semantic Aspects", and (3) "Approach". Within this framework, Jenkinson concluded from her analyses that higher achievers tended to be more precise. Their responses contained a greater number of discrete ideas, and showed greater relevancy to the task. More efficient use of context was also indicated. On the other hand, low achievers on the cloze tended to give responses that were vague and repetitious. Irrelevant ideas were common and often led to misinterpretations. Ideas expressed tended to be at a surface level. Letton (1958) considered grade nine students thought processes in understanding poetry. From her analyses of introspective-retrospective protocols, combined with information about experiential background and attitude towards poetry, she concluded that experiential background contributed significantly to success in interpreting poetry. The higher level achievers revealed more personal reactions to the poem's content. They tended to integrate more often the ideas expressed in the poem with their background experiences. In addition, higher level readers were able to (1) use context more efficiently to get meaning, (2) make acceptable inferences, and (3) summarize the poet's ideas.

While none of these studies was designed to explore inferencing specifically, all have identified inferencing as an important factor distinguishing the more efficient and less efficient reader. They have indicated differences across age levels, and ability levels, to select appropriately from the stated information to make inferences. Further, the ability to recognize and remain within the constraints of the given text has emerged as a distinguishing variable.

More recently, Simpson (1976) attempted to describe inferential comprehension based on the data gathered from a story telling task based on a wordless picture book. The sixty-three subjects for this study were drawn from kindergarten (n=21), grade two (n=21), and grade four (n=21) in one middle-class suburban school. On the basis of standardized test results, subjects at each grade level were classified as high, middle or low in reading achievement.

Each subject individually told his story for the same preselected wordless picture book. These were tape recorded and later transcribed. The transcribed protocols were analyzed into T-units, and inferential responses were identified. Based on the subject's stories, Simpson developed a classification system based on the classic literary elements of setting, characters, and plot. Each subject was also required to answer orally five predetermined inferential questions. Inspection of these questions revealed that both forward and backward inferences were included in the task. Little explanation is provided on the scoring of the subject's responses other than they were marked as correct or incorrect.

Among the conclusions reached by Simpson (1976, p.131) were the following: (1) inferential comprehension was reflected in the story telling of subjects at all grade levels; (2) inference production increased from kindergarten to grade four; (3) production of inferences generally was not a function of reading level; (4) inaccurate inferences increased from kindergarten to grade four for the low readers. Simpson also concluded that inferential comprehension was best viewed from an interactive-constructive perspective.

Simpson's data have clearly indicated the developmental characteristic of inference. However, one must question the generalization of inference generation on a story-telling task to inference generation in a reading task designed to understand an author's intended message. The two tasks appear to differ qualitatively. The latter would seem to be much more constrained by the given information than is the former. Thus, quantitative differences may also exist. The need to remain within the constraints of the given information in order to understand the author's message appears to have received little attention. Once T-units were identified as inaccurate inferences they were discarded from the analyses. The reporting for the scoring of the response[illegible] the inference questions does not indicate whether the subject's use of support from the given information, and his precision in linking the support words with his response were considered. Both aspects would appear to provide greater insight into what the subject was doing, than merely scoring the response right or wrong. Finally, while the classification system developed by the investigator provided interesting data from a literary viewpoint, it does little to clarify the actual processes involved in a subject's generation of an inference.

In 1917, Thorndike considered reading within a problem solving framework, and observed that reading was "a very elaborate procedure, involving a weighing of each of many elements in a sentence, their organization in the proper relation one to another, the selection of certain of their connotations and rejection of others..." (p. 323). Thorndike has identified three distinct processes, namely, selecting, weighing, and organizing. These appear to be essential to inferencing as described in the aforementioned research. The processes of selecting and weighing information have been indicated by the Chicago studies to be essential in the drawing of inferences. The drawing of inferences may indeed be essential to the organizing processes. This latter concept will be discussed in greater detail in the next section.

Reading Research at the Discourse Level

A survey of available methodology texts in reading instruction revealed that comprehension generally was dealt with in terms of unit size, varying from the word, through the phrase and sentence, to the paragraph. Discourse comprehension seldom received attention. When commented on, it was covered in a very cursory fashion. Undoubtedly this state of affairs is a reflection of the research into comprehension which, by and large, has been carried out at the word, sentence, or paragraph level. The limited research attention on discourse comprehension has focused on high school or adult subjects. One such study was carried out with grade eleven students to explore how the subjects read a short story (Strang and Rogers, 1965). As well as the retrospective interview which was composed of two parts, a free response followed by a structured response to specific comprehension questions, Rogers used two questionnaires to gather data about subject attitudes, background knowledge about short stories and short story writers, and the impression made by the short story used as the test instrument. Analyses were made of the protocols, transcribed from the interviews, and of the data collected by means of the questionnaires. From her findings, Rogers concluded there were differences within as well as between ability groups. A major difference was reported in the area of attitude, in that the high ability students tended to be much more positive than the low ability. Further, high ability subjects were more aware of the story elements, and could identify main events more readily. Rogers also reported a greater awareness of the processes of reading for the high ability subjects. While Roger's study is representative of the limited research into the discourse level of comprehension with high school subjects, there have recently been suggestions that discourse comprehension needs to be explored with less mature subjects (MacGinitie, 1975; Miller, 1976).

MacGinitie (1975) has attempted to present in a concisely organized format the research needs suggested by the literature search in reading which was carried out earlier under the direction of Davis

(1971). Under the heading "Comprehension", MacGinitie (1975, p.22) has stressed the need to consider "sentence inter-relationships" and "larger organizational structures". He pointed out that "much of the problem of understanding a written passage often depends on logical relations among the facts given by a sentence or scattered among different sentences", (pp.22-23). As a result, he has recommended the study of "the strategies, operations, and cues that different people actually use in understanding (or misunderstanding) written materials of different sorts, as well as the operations that the materials appear to require", (p. 24). Inferencing appears to provide a perspective from which such between and beyond sentence processing may be explored.

In a similar vein, suggestions have been made for text comprehension research by the members of the National Institute of Education Conference on Studies in Reading (Miller, 1976). This conference considered reading from a number of perspectives, one of which was entitled "Text Comprehension Skills and Process Models of Text Comprehension". The members of this panel recommended as one goal for reading research the identification of "those skills that are important for text comprehension, as distinguished from word or sentence comprehension, and to determine how these skills can be taught", (Miller 1976, p.709). Undoubtedly this awareness of the differences of, and need for understanding in discourse comprehension has been encouraged by recent developments in the field of psycholinguistics.

Psycholinguistics Research Into Discourse Comprehension

Psycholinguistics is a relative neophyte among recognized disciplines of language study, having been conceived and given reality in the early fifties. The term was formally adopted and its acceptance promoted in an attempt to focus more precisely on the psychological processes that enable man to use language (Blumenthal, 1970). Viewed historically, this was an innovative move in light of the strong behavioural bias of the psychological research of that period.

Much of the research that evolved out of this "psycholinguistic revolution" focused on the sentence as the unit of analysis. This is not surprising since the major theoretical framework within which the research was undertaken has been the transformational-generative grammar posited by Noam Chomsky (1957, 1965). The initial focus of much of this research centred on the listener's understanding of spoken language. As a result the major emphasis of psycholinguistic research has been on the oral mode of languaging. The direct application of the findings of such research to the written language mode has proven to be fraught with problems.

In the early sixties, it was assumed that once the sentence was understood, the knowledge so gained could be extended directly to discourse comprehension. However, as Carroll and Freedle (1972) have cogently pointed out, the problems in sentence research proved to be much more complicated than originally thought. These writers also suggest that the interest in discourse has resulted from a growing disenchantment with the transformational-generative grammar as a theoretical explanation of the psychological reality of the processes in language production, comprehension, or acquisition.

A major area of contention has been the role of semantics. Chomsky (1957, 1965) has maintained that semantics is an interpretive component, while others have viewed semantics as a generative base (e.g.

Katz and Postal, 1964; Chafe, 1970). In this latter school of thought, Chafe (1970, p.347) pointed out that "many semantic constraints exert their influence across the boundaries of sentences". Thus, the re-introduction of meaning into linguistic study appears to have hastened that consideration of the discourse level of communication.

Research into discourse comprehension has emerged as an identifiable area of psycholinguistic research in the last decade. Following the earlier sentence research, the major focus of attention has been the oral language mode. Since 1970 interest in the written mode has become more prevalent in psycholinguistic research. The study of discourse comprehension within psycholinguistics is a developing field of research, and as such has not yet evolved an overarching theoretical framework. Rather the area is marked by a number of emerging theories which utilize various perspectives for their bases. Research in memory has served as a springboard for some theories (e.g. Crothers, 1972; Rumelhart & Norman, 1975). Others have developed within a learning focus (e.g. Fredereksen, 1972; Frase, 1972). A third approach has been via mental operations (e.g. Trabasso, 1972). Many of these models have been developed on the basis of auditory input. The direct application of such models to visual input raises questions regarding the constraints that each mode places on comprehension. Research has shown that the two modes are not synonymous (Walker, 1973; Neisser, 1967; Drieman, 1962).

One major factor that has contributed to this recent interest within psycholinguistic research at the discourse level has been the development of a number of discourse analyses techniques. These techniques generally reflect the idiosyncracies of the tasks for which they were developed, and the background of the researchers who have developed them. One major difference among the available techniques has been identified by Meyer (1975). She has divided the techniques on the basis of whether the analysis has been based on "the analysist's analysis of the logic inherent in the text" or "strictly on the author's organization of the information in the passage". Crother's (1972) work is based on the former. The second category appears to be the larger and has a number of variations within it. The major theorectical base for these works has been Fillmore's (1968) Case Grammar. Olson (1972) based his analyses directly on the case relations expressed by Fillmore. Meyer (1971, 1975) has combined Fillmore's case relations and Grimes' rhetorical relations. Frederiksen (1972) drew on the earlier work of Dawes (1966) which stressed the conceptual content and the set relations thereof and the case grammar, as well as Minsky's (1968) work with frames in artificial intelligence. The foregoing techniques have been used with expository prose selections usually of single paragraph length. More recently, Rumelhart (1975) has developed a story grammar which analyses the internal structure of narrative prose with multiple episodes. This approach also reflects the work in artificial Intelligence. In particular it is related to the research and theory espoused by Schank (1974, 1975) which will be discussed in a later section of this chapter. For the present study, the discourse analyses were based on the Rumelhart Story Grammar for a number of reasons: (1) it was the most appropriate for narrative prose, (2) it could analyse multiple episodes, and (3) it reflected the theoretical base of Schank. A more detailed discussion of the story grammar and its analyses has been provided in Chapter 4, as part of the discussion of the stimulus stories used in this study.

Having looked at inference and discourse reading comprehension in general, the remainder of this chapter will be devoted to a review of selected research from language-related disciplines. This literature will be considered within the framework of Ruddell's model. First, the "Aspects of Meaning" will be explored in light of a developing theory of meaning. This will be followed by a review of research which appears more related to the "Interpretation" components of the model.

"ASPECTS OF MEANING" AND INFERENCE

As defined in Chapter One, an inference needs to be supported by information (either explicit or implicit) in the text. Thus, in Ruddell's Model, "Aspects of Meaning" would appear to form the basic materials for the inference process. In this selection a theoretical statement about meaning as developed by Baker, Prideaux, and Derwing (1973) will be presented in an attempt to delineate more specifically the aspects of meaning available to the reader for a given text. In particular, this theory is felt to explicate Ruddell's "Relational Meaning", and adds the aspect of contextual information to provide a more comprehensive approach to meaning.

The role of context in understanding meaning has proven a concern which has led to, and been underscored by, the study of discourse comprehension (Chafe, 1970; Rommetveit, 1974). As Russell (1970, p.156) has pointed out, "the approaches to meaning have been characterized by diversity rather than unanimity". Although different attempts have been made to accommodate meaning, a theoretical model that appears to have potential for exploring the kinds of information used to construct meaning from a written message has been proposed by a group of researchers in the Department of Linguistics at the University of Alberta (Baker, 1976; Prideaux, 1975; Baker and Prideaux, 1975; Baker, Prideaux and Derwing, 1973). In their "Information-Structure" theory, meaning has been viewed as a foundational component. Prideaux (1975) has represented this relationship as follows:

meaning
↕
information structure
↕ syntactic rules
syntactic structure
↕ phonological rules
phonetic structure

One assumption of this model is that the information structure is not a unitary concept, but rather a composite of four nested aspects of information which have been identified as denotational information, relational information, sentential information, and contextual information. These four aspects of meaning have been suggested in the following embedded relationship:

$$[I_c (I_s (I_r (I_d)))]$$

These four aspects of the Information Structure have been identified the following way:

(1) I_d Denotational Information

"refers to the information conveyed by specific lexical items" (Prideaux, 1975, p.12) "most commonly realized in an utterance as nouns and verbs with appropriate modifiers as required by the situation, audience, and preceding linguistic context". (Baker, 1976, p.9).

(2) I_r Relational information

"refers to the varlous grammatical functions played by syntactic constituents", (Prideaux, 1975, p.12). "These are conveyed linguistically by such devices as word order or inflectional markings tagging the units, for the most part, as grammatical subjects, verbs, or objects", (Baker, 1976, p.10).

(3) I_s Sentential Information

"refers basically to sentence type: declarative, interogative, or imperative", (Prideaux, 1975, p.12) "refers to the general intent of the utterance, to provide or request information. This is realized through word or constituent orderings, or by non-denotative lexical items which affect the interpretation of the whole utterance", (Baker, 1976, p.11).

(4) I_c Contextual Information

"refers to the contextual or discourse factors which govern the syntactic shapes of the sentence", (Prideaux, 1975, p.12).

"what has been linguistically established prior to the use of the particular utterance under consideration.... there should be a distinction, though, between this explicitly linguistic context, and the kind of implicit context which can be created by the speaker's presuppositions about the mental state of the hearer. These latter are clearly non-linguistic and part of the cognitive background in which the utterance and its predecessors are embedded", (Baker, 1976, p.12).

These definitions provided by the authors of this theory of Information Structure clearly emphasise the oral-aural channel of communication. While founded on the oral mode of languaging, the approach seems to provide a useful framework for assessing the kinds of linguistic information which has been provided by the author, that the reader utilizes to make his inferences. Meaning, when operationalized in this manner, seems to be more manageable, and the procedures utilized to obtain meaning may be clarified. Such a classification may be useful in describing the kinds of information used by maturing readers when drawing inferences from narrative discourse.

ASPECTS OF INTERPRETATION AND INFERENCE

In the preceding section an information structure of meaning has been suggested as a profitable perspective from which the generation of inference may be considered. The background discussion will now focus on what the reader may do with that information. The literature and research discussed has been selected to help clarify the cognitive processes related to inferencing within the integrative thinking that Ruddell has included as an important component of the aspects of interpretation. Recent writers in the field of reading have pointed out that reading involves the processing of various kinds of information coded in the graphic display of print. (Smith, 1975; Geyer and Kolers, 1974; Goodman, 1973; Hansen, 1971). Goodman (1969) has identified three types of information so coded as grapho-phonic, syntactic, and sematic. The primary concern of the present study will be the latter two.

The concept of the reader as a processor of information has been based on the application of the theory and research growing out of the field of information processing. While this area of study has a number of facets (Hansen, 1971), only one sub-area will be considered here, namely the natural-language-user model (Hansen, 1971). More specifically the theoretical work of Schank (1975, 1972, 1969) will be briefly reviewed in order to clarify two kinds of inference identified as "forward looking and backward looking". This will be followed by a discussion of the two kinds of cognitive synthesis described by Luria (1966a, 1966b) as successive synthesis and simultaneous synthesis. The more recent work by Das and his associates (1975) in which Luria's concepts are placed within an information processing framework will also be considered.

Information Processing and Inference

As originally conceived, information processing theory might have been more accurately thought of as a theory of information transmission (Osgood and Sebeok, 1965). The focus of the early work in this area was on the uncertainty of events, which has been technically termed entropy. As such, the field was originally an extension of mathematical probability. However, this early transmission theory has been replaced by more complex problems with advances in computer technology made over the last decade, and the recent stress on meaning and language understanding, (Schank, 1975).

In very simplified terms, information processing has been built on the assumption that a task can be analyzed into a series of stages that take place over time. The order of these stages is set, beginning with an input, followed by what may be termed a throughput stage, and ending with an output. In the human information processing system, the throughput is covert in nature, and therefore is not directly available for objective observation. In silent reading, not only the throughput but also the output (i.e. the end result of understanding the writer's message) is covert, unless another reading-related task is provided that forces an external response. This covert nature of two out of three of the information processing stages has made the assessment of cognitive processes used in reading a difficult task. It has been suggested (Hansen, 1971) that information processing theory may provide direction for exploring these covert processes.

By studying the programming of computers designed to deal with natural human language, insightful hypothesis have been generated regarding the processing of information to arrive at understanding, or for memory storage. These hypothesis are valuable providing it is recognized that the computer has been programmed for the outset to complete prespecified tasks, and thus lacks the degree of flexibility, spontaneity,and innovation that is the essence of human information processing.

Schank's Theory of Conceptional Dependency. Much of the research that was carried out in the study of cybernetic processing of natural human language dealt initially with parsing or generating language (Schank, 1975). More recently with greater stress on meaning and understanding, this focus, which reflected the Chomskian model referred to earlier, has been altered. One theory of natural language understanding which reflects the current interest in meaning and has as its base information processing research is the theory of conceptual dependency proposed by Schank (1969, 1972, 1975).

In 1969, Schank wrote the first paper in which he attacked the transformational-generative grammar proposed by Chomsky as inadequate to explain language processing. He was very critical of the competence model based on syntactic structures, and proposed as an alternative a conceptually-based theory of natural language undertanding. In a later article (Schank, 1972) he explicated in detail the formal postulates of his theory. He claimed that a conceptual base existed which was interlingual, and "unto which linguistic structures in a given language map during the understanding process and out of which such structures are created during generation". (Schank, 1972, p.554) In a summary statement on this conceptual base, Schank (1972, p.554) stated:

> What I am suggesting then is that such a conceptual base exists; that its elements are concepts and not words; that the natural language system is stratified with the actual language output being merely an indicator of what conceptual content lies beneath it; and that the conceptual apparatus that we call thinking functions in terms of this conceptual base and the relations between these concepts as operands.

The key elements of this theory are the concepts, and relations between these concepts. Although the term "concept" is never explicitly defined, three major kinds of concepts have been identified and described as follows (Schank, 1972, p.557):

(1)	Nominals	(i.e. those things that can be thought of by themselves without the need of relating them to some other concept--a nominal tends to be a picture producer (PP))
(2)	Actions	(i.e. that which a nominal can be said to be doing--the core of most verbs in the language --these acts have been identified as four major types)

(3) Modifiers (i.e. a description of the nominal or action to which it relates and serves to specify an attribute of that nominal or action--picture aiders (PA) or action aiders (AA))

A crucial element of this theory is the dependency relationships that exist between and among these basic components to constitute a conception. A complex rule system has been developed to account for these dependencies.

Schank's View of Inference. In his more recent work on the representation of an episode in memory, Schank (1975) has focused on the role of the inference. He has proposed (1975, p.238) that in the processing of information to establish conceptual dependencies, "missing information can be as important as given information". This critical missing information would appear to be related to the cognitive processes commonly termed inferencing. Regarding the drawing of inferences, Schank (1975, p.238) suggested that the information processes required at least two fundamental abilities. These were: (1) "how to use context to direct inferencing", and (2) "when to stop making inferences". He stated that the linkage in a paragraph was the result of a causal chain of dependencies underlying the text, and identified four kinds of causation (pp. 241-242): result, enable, initiation, and reason. The first described the direct cause of an ACT; the second allowed an act to occur, but did not necessarily cause it; the third initiated thought; the fourth described the interface between mental decision and their mental effects.

Within a paragraph, the role of the sentence has been viewed by Schank (1975) as twofold: (1) to supply information, and (2) to set the stage for the sentence that follows. When information is not supplied to set the stage for the following sentence, the receiver of the message must supply the needed informational framework in order to establish coherence with what has gone before. This concept is reflected in Schank's (1975) differentiation of two types of inference: (1) backward-looking inferences and (2) forward-looking inferences. The difference between the two kinds of inference may be summarized as follows. A backward-looking inference is required to establish the framework for each input conceptualization for which the necessary conditions have not been explicitly provided. On the other hand, a forward-looking inference is a state that is inferable from established conditions based on input conceptualizations.

These inferences play an important role in Schank's (1975) discussion of the representation of episodes in memory. He has described this memorial representation (1975, p.244) in terms of "a combination of conceptualizations underlying the individual sentences of the paragraphs plus the inferences about the necessary conditions that tie one conceptualization to another or to a given normality condition". He (Schank, 1975, p.244) went on to stress that an important "part of the process of understanding is the tying together of the necessary conditions with the established conditions". In this theory, inference is viewed as an important aspect of "tying together" the conceptualizations so that one can understand.

Selected Psycholinguistic Studies of Inference

Since the early 1970's a limited number of psycholinguistic researchers have begun to explore the area of inference. These studies have reflected a memory research base. Thus, the chief means of studying inference has been a recognition memory task. Such a task involves two phases. First, there is an acquisition phase during which the subject is presented with stimuli materials and instructed to study these and remember them so he will be able to answer questions about them. In the second phase, that of recognition, the original materials are removed and a number of test items are presented. These include both items which were in the original materials and items which are new. Some of the latter are acceptable; others are not. The subject is asked to judge whether the test items were identical to those presented in the acquisition phase. Such studies will now be discussed.

Studies with Adults. Support for the psychological reality of the role of inference in understanding can be found in sentence comprehension research of which Bransford and Franks (1971) is an example. They explored aspects of meaning, memory,and inference with university undergraduates. Working with oral language input, these researchers analyzed complex sentences into simple sentences. These simple sentences, and combinations thereof, were orally presented on a tape recorder to the subjects. The entire complex sentence was never presented as a unit, although all the semantic aspects had been exhausted in the simpler sentence presentations. After the oral presentation of the simpler sentences, the subjects were provided with a list that was comprised of the simple sentences, the simple combinations, and the complex sentence. The researchers found that the subjects chose with a high degree of confidence the complex sentence as the representation of what they had heard. Since the subjects gave the highest confidence ratings to the total complex sentence which required establishing inferred relationships, the researchers concluded that the subjects had "integrated the information communicated by the sets of individual sentences to construct wholistic semantic ideas". (Bransford and Franks, 1971, p.348). Further studies in sentence memory with university students led Bransford, Barclay, and Franks (1972) to conclude that sentence comprehension was constructive rather than interpretive. They (Bransford, Barclay, Franks, 1972, p.20) pointed out that "people carry meanings, and linguistic inputs merely act as cues which people can use to recreate and modify their previous knowledge of the world".

Although inference has been established as an important variable in sentence comprehension (Barnsford, and Franks, 1971; Barnsford, Barclay, and Franks, 1972; Just and Clark, 1973), as yet only limited research is available that has considered the role of inference in discourse comprehension. One available study of the discourse level has been carried out by Thorndyke (1976). In two studies with university students, Thorndyke attempted to examine how inferences are used to aid connected discourse comprehension. In the first study the stimuli used were four unrelated written narrative discourses. The mean length was 20 sentences. Two "target-continuation" pairs of sentences were embedded in each text. In the control task no inference was required to link the target and continuation sentences. In the experimental tasks, the continuation sentence required the use of the target sentence and an inference. The target-continuation sentences were clearly marked by a slash. Each subject read up to the slash and then wrote down a minimum of three inferences that could be drawn at that point based on the previously provided text information. This was continued to the next slash, and so on until the stories were completed. Following this, each subject was required to rate the plausibility of a list of inferences about the test passages. A seven point rating scale was used. From his analyses of the results Thorndyke (1972, p.442) found that in the control task there was no difference in the plausibility ratings of appropriate, inappropriate, or neutral inferences. The experimental group rated appropriate inferences most highly, and inappropriate inferences as lowest. He (1972, p.442) concluded that "the results of Experiment 1 confirmed the expectations about salience (i.e. production frequency) and the plausibility of the pre-selected experimental inferences". From this he hypothesized that inferences generated during comprehension were stored with the text information in the human memory system.

Experiment II was designed to explore the contextual integration of inferences and textual information. Each subject was required to read the four passages, and when each was completed to rate the passage on meaningfulness, comprehensibility, and imagery. After reading all four stories, each subject completed a memory test in which the experimenter read a set of 12 sentences (6 from the stories, and 6 inferences). The subjects had to identify each sentence as being actually from the story or being an inference. The probability for recognition of actual sentences from the story was found to be very similar for the control (.84) and experimental (.86) task. There was a marked difference between the mean false alarms probabilities for inappropriate inferences for the control (.22) and the experimental (.06), and for the appropriate inferences the difference was again significant (p. 05) with the control attaining .21 and the experimental .58. From his findings Thorndyke (1976, p.444) concluded that "the sentence is stored in an integral structure with its associated inferences", and that "the generation and storage of inferences plays an important role in the comprehension of prose passages". While these findings and conclusions give support to the importance of the role of inference in discourse comprehension, they were carried out with adult readers and therefore cannot be applied directly to the maturing reader.

Studies with Children. Most research into inference has been carried out with adult subjects. However, the work of Paris and his associates (1973, 1974, 1974, 1975) has focused on subjects of elementary school age. These researchers have explored further the findings of Bransford and Franks with children.

Paris and Carter (1973) designed tasks similar to those used by Bransford and Franks to determine whether children also demonstrated constructive memory ability. Twenty elementary school children, ten from grade two and ten from grade five in one private school, were studied. Each subject was tested individually using oral language stimuli. During the acquisition phase he was presented with seven unrelated "stories". It should be noted that these were not stories in the regular sense. "Each story was comprised of three simple active, declarative sentences: two premise statements and a filler sentence." (Paris and Carter, 1973, p.110). In the recognition phase of the task the subject received four test sentences for each story: "a true premise sentence, a slightly altered false premise, a permissable A-relation-C true inference, and an invalid false inference in which the rational terms were incorrect." (Paris and Carter, 1973, p.110) A five minute block sorting task separated the acquisition and recognition phases. Analyses revealed identical patterns of errors for the grades two and five subjects. "Subjects consistently responded affirmatively that they had previously heard the true-inference statements when in fact they had not." (Paris and Carter, 1973, p.111) No significant differences were found in terms of the subjects' sex. However, the subjects from the second grade made more errors than their counterparts in the fifth grade. The subjects consistently made most of their errors on the recognition of true inferences as being part of the original materials. The false inferences were considerably fewer in number. The researchers concluded that elementary school age children were able "to implicitly and actively acquire, construct and retain semantic information implied within sentences." (Paris and Carter, 1973, p.112) In keeping with the previous work of Bransford and Franks (1971) with adults, the children in this study were found to recognize consistently "the nonpresented, semantically congruent true inferences" as part of the original stimuli heard during acquisition.

Paris and Mahoney (1974) went beyond the oral language mode to pictorial information and explored children's cognitive integration. The subjects were chosen from grades two (n=36) and four (n=36). The subjects were randomly assigned to three experimental groups at each grade level: (1) verbal acquisition - verbal recognition, (2) picture acquisition - verbal recognition, (3) picture acquisition - picture recognition. A recognition-memory task was again the data gathering technique used. In this study the inference items in the recognition phase focused on spatial relationships: "right and left, above and below, higher and lower, and in front of and behind." (Paris and

Mahoney, 1974, p.635).

From their analyses, they reported a significant grade x group x premise inference interaction, and a significant group x story interaction. They observed that the second grade subjects gave more "yes" responses than the fourth grade subjects in the "verbal-verbal" and "picture-picture" conditions. At both grade levels, subjects gave significantly more "yes" responses across the three condition groups for the true premise and true inference items. Further analyses of the group x story interaction revealed that the stories involving right left inferences were the most difficult.

They concluded that the "children have difficulty differentiating semantically consistent inferences from original sentences" (p.639). The study demonstrated "the reliability of the semantic integration phenomenon with a variety of spatial locative relationships in children's sentence memory" (pp.639-640). As well, the study extended "the semantic integration paradigm to pictorial stimuli" (p.640). In their discussion of their findings, they suggested that comprehension was indeed a constructive cognitive process "not unlike Piaget's notion of assimilation to schemata." (p. 640) They go on later to state that "such a proposal regards comprehension as an integrative process and considers different cues to vary in weight or information." (p.641)

In another study Paris and Upton (1974) further explored inferential behavior with seventy-two elementary school-age subjects. Twelve children were studied from each grade level from kindergarten to grade five. They designed their study to explore differences among inference types. The two types of inferences that they identified were (1) contextual and (2) lexical. The former included presuppositions and inferred consequences, while the latter was made up of semantic entailment (object as subset of larger class) and implied instruments (verb implies particular instrument to accomplish action).

Each subject was tested individually. The investigator read six paragraphs to each individual subject. These paragraphs varied from six to nine sentences in length. After each paragraph the subject orally responded to eight orally presented "yes-no" questions. These included both explicit information from the paragraph and implicit relationships described above in terms of the four types of inference.

Percentage scores were calculated for each subject based on his responses to the "yes-no" questions. This was done for both verbatim performance and inference performance. When the data was submitted to an analysis of variance a significant difference was found between the subjects' performances on the verbatim questions and the inference questions. The latter were answered correctly more often. Since there was some indication of response bias (kindergarten subjects gave 72% "yes" responses and grade five subjects gave 48% "yes" responses), the data were submitted to a signal-detection analysis. Even when response bias was accounted for, the inference performance was significantly superior to the verbatim performance. A comparison of the subjects' performances based on lexical versus contextual inferences revealed a superior performance on the lexically based questions. Both verbatim performance and inference performance consistently improved from kindergarten to grade five. To explore whether this increase in performance was due to improved memory only an analysis of covariance was carried out. Both lexical and contextual inference performance improved even when the effects of memory were partialled out.

From their findings they concluded that children from approximately age six to age eleven increase significantly in the amount of both explicit and implicit information comprehended from a paragraph. This increase appears to reflect more than merely an increased memory span. Children's performance on inference questions appears to be related to the kind of inference being questioned (contextual vs lexical).

In each of the studies discussed in this section the oral mode of language processing was used in the stimuli presentation. This weakens the generalizability of the findings to reading tasks where the written language mode is the method of communication. Much of the work presented has considered inference at only the sentence level. Indications from the work of Thorndyke (1976) and Paris and Upton (1974) clearly indicate the need to consider inference in the broader context of discourse. In the Bransford and Franks (1971) study, as well as the work by Paris and his associates (1973, 1974, 1974, 1975) the major research task has been one of discrimination. In the recognition-memory task, all the information in the recall phase is provided by the investigator. The subject is required to make judgements as to whether the items were or were not in the original materials presented in the acquisition phase. To generalize the findings of a discrimination task to an individual's ability or tendency to generate inferences while reading would appear to be unwise. The generation of an inference would appear to be related more directly to the individual's cognitive processing, and might provide greater insight into the processing strategies used by maturing readers in making inferences while reading continuous discourse. The information processing perspective provides an opportunity to consider the processor while he is processing an inference. Paris (1975) has described inference as a process of expansion which facilitates integration. The next section explores the concept of integration within the theoretical framework of Luria's (1966a, 1966b) cognitive synthesis.

Cognitive Synthesis and Reading Comprehension

As pointed out earlier, cognitive processing is currently viewed as a prerequisite and corequisite for reading comprehension. It provides the means for understanding the information, either stated or assumed by the author, and coded in the graphic display of the reading selection. Cognitive synthesis has been identified as an essential sub-process. This section will focus on the theory of A. R. Luria (1966a, 1966b, 1970), and derivational studies by Das and his associates (1975), Leong (1974), Kirby (in press), and Latham (1973). At the outset, it must be recognized that the exact components of the brain, and the related processes that are responsible for language production and reception are not known in detail. (Lenneberg, 1967; Jacobson, 1975). The present study has not been designed to explicate the components of the brain or any physiological activity that may be related to the generation of inferences during the reading of written narrative discourse.

Luria's Theory. Luria's (1966a,1966b,1970, 1973) theory of dynamic functional systems which attempts to explain the organization and workings of the human brain provides a theoretical framework for exploring aspects of the type of cognitive processing involved in reading comprehension. In his discussions of complex functional systems, Luria (1970, 1973) has identified three distinct "blocks" of "functional units" that have specific cognitive roles. These have been identified in the following manner: Block one-the upper and lower parts of the brain stem, the reticular formation, and the hypocamus: Block two-the posterior area of the cerebrum, including the occipital, parietal, and temporal lobes: Block three-the anterior area of the cerebrum, the frontal lobes. From his observation of aphasic patients with lesions in various areas of the brain, Luria has identified functions related to each block. These have been summarized in Figure 2.2.

These blocks have been viewed by Luria in terms of "a unit for regulating tone or waking, a unit for obtaining, processing, and storing information arriving from the outside world, and a unit for programming, regulating, and verifying mental activity". The importance of Block one would appear self evident since reading as a process is carried out during a state of consciousness. Block three may also have implications for inference in reading. However, at the present time, the psychological functions related to Block three have not been operationalized in ways that can be discretely measured.

Block two appears to provide some direction for the present study, since the focus is on the processing of incoming information that is essential to understanding inferences in narrative discourse. One aspect of this processing is the drawing together, integrating or synthesizing the incoming information. Luria (1966a, 1966b) has written insightfully about language synthesis processes based on his own studies. His work has been carried out within the theoretical

Block	Corresponding Brain Parts	Functions
I	brain stem reticular formation hypocamus	- regulates energy level and tone cortex - provides basis for organization of various processes
II	- posterior parietal and occipital lobes, and the lateral temporal lobes of the cerebrum - organized into three hierarchical cortical zones	A. Primary Zone - sorts and records sensory information B. Secondary Zone - organizes information further and codes it C. Tertiary Zone - information from various sources overlap and form the basis for organizational behavior
III	frontal lobes of the cerebrum	- formation of intentions and programs, decision making.

Figure 2.2 SUMMARY OF LURIA'S "FUNCTIONAL SYSTEMS" OF THE BRAIN

framework of Sechenov (1878, reprinted 1973) and Vygotsky (1931, reprinted 1966).

A major focus of Luria's work has been on what he has termed "afferent synthesis". His major concern has been how the human brain processes and makes sense out of the deluge of sensory information provided by the body's sensory organs. From his explorations, he (Luria, 1966a, p.74) concluded there was "strong evidence for distinguishing two basic forms of integrative activity in the cerebral cortex". These he identified by the terms used earlier by Sechenov in 1878 as simultaneous and successive synthesis. In his explorations of these two basic forms of cognitive information integration, Luria (1966a, p.74) pointed out that simultaneous synthesis dealt with "the integration of the individual stimuli arriving in the brain into simultaneous, and primarily spatial groups". Successive synthesis dealt with "the integration of individual stimuli arriving consecutively in the brain into temporally organized, successive units".

It was from his studies with aphasic patients with brain lesions that Luria concluded that simultaneous synthesis was controlled by the areas of the brain already identified as the occipital and parietal lobes. He has shown that simultaneous synthesis takes place at three different levels. These are: (1) the sensori-perceptual (visual, tactile, olfactory), (2) mnestic (memorial), the basis of symbolic activities such as speech and writing, and (3) the intellectual level (mathematical and logico-grammatical relationships). Although three levels have been identified, Luria has stressed their interactive nature. While the third is built on the former two, it in turn allows for the abstraction of the first through the second.

In his discussion of successive synthesis, Luria (1966a) again dealt with three levels, the sensori-perceptual, the mnestic, and the intellectual. The sensory input is primarily of an auditory or motor nature. This type of synthesis has been identified with the fronto-temporal lobes. Successive synthesis at the first level is indicated in the production of spoken words, which requires the successive synthesis of speech sounds. Likewise writing requires a sensori-motor level of successive synthesis. Following verbal directions of a multiple nature is indicative of mnestic-intellectual levels. As Luria has pointed out, the last level involves the mental processes identified as thinking. From this discussion it would appear that both types of synthesis may play important roles in inferencing.

Das' Interpretations. Das and his associates have used Luria's findings to develop an information processing model of information integration. (See Figure 2.3). This model is composed of four major units: "the input, the sensory register, the central processing unit, and the unit for output". (Das, Kirby and Jarman, 1975, p.89). The unit of greatest significance for the current study is the central processing unit within which the synthesis processes and the planning and decision making processes make sense out of the incoming information.

It may be argued that the model in its present state is somewhat simplistic since it lacks the complex feedback systems that are usually associated with information processing models. Further the model appears to reflect heavy behavioural overtones in its representation of information integration as passive, and by and large a unidirectional procedure, and therefore does not adequately represent the active role of the reader in processing the printed message of written discourse. However, the research from which the model has been generated has consistently indicated two types of information integration: spatial (simultaneous) and temporal (successive). Stability of these two general information integration factors has been found across age (Molloy, 1973; Cummins, 1973), socio-economic status (Molloy, 1973),

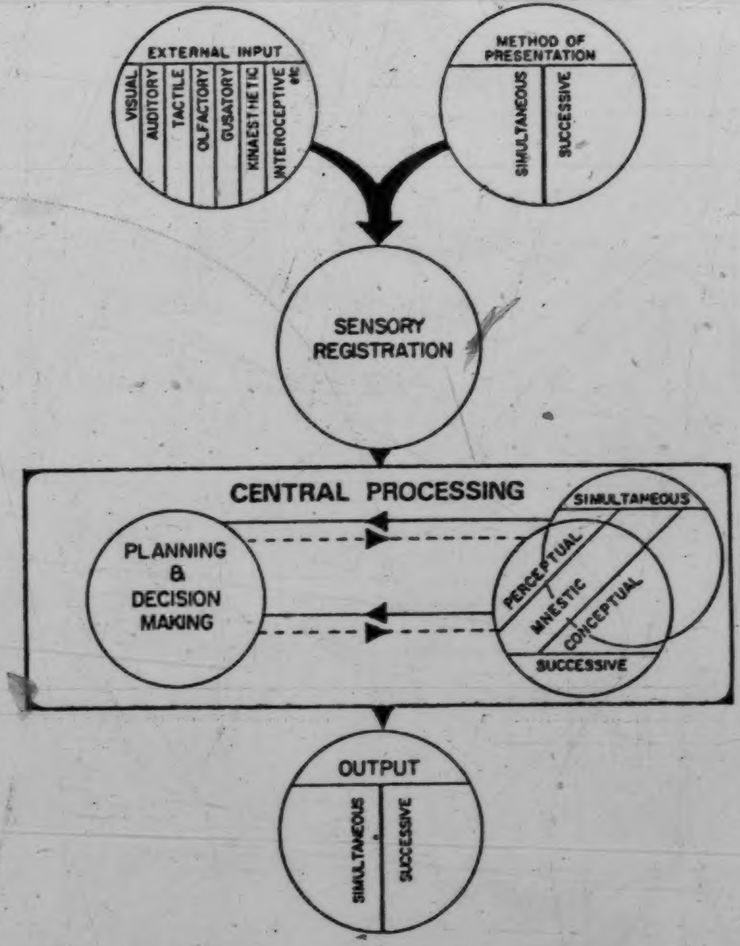

EXTERNAL INPUT
VISUAL
AUDITORY
TACTILE
OLFACTORY
GUSATORY
KINAESTHETIC
INTEROCEPTIVE etc
METHOD OF PRESENTATION
SIMULTANEOUS
SUCCESSIVE
SENSORY REGISTRATION
CENTRAL PROCESSING
PLANNING & DECISION MAKING
SIMULTANEOUS
PERCEPTUAL
MNESTIC
CONCEPTUAL
SUCCESSIVE
OUTPUT
SIMULTANEOUS
SUCCESSIVE

Figure 2.3 INFORMATION INTEGRATION MODEL
(after Das, Kirby & Jarman, 1975)

culture (Das, 1973, Krywaniak, 1974) and levels of ability (Das, 1972; Leong, 1974; Jarman, 1975). The foregoing researchers have operationalized simultaneous and successive synthesis in terms of a battery of individual tasks. Although tasks have been deleted and other tasks added (on occasion), the basic core battery has consisted of (1) Raven's progressive matrices, (2) Figure copying, (3) Memory for design, (4) Cross-model coding, (5) Visual short term memory, (6) Serial recall (auditory mode), (7) Free recall (auditory mode), (8) Word reading and (9) Colour naming (after Stroop). Based on factor analytic procedures, the first four tests (1, 2, 3, 4) have been found to load on one factor which has been identified as simultaneous information integration. All these taskes involved the spatial integration of the incoming information. The next three tasks (5, 6, 7) have loaded on a second factor, which has been identified as successive information integration. All these tasks involved integration of incoming information successively over time. The last two factors have loaded on a third factor identified as speed. The stability of these findings appears to provide a pool of tests from which can be selected suitable tasks for assessing selected grade four readers' synthesizing processes. One could then relate the two types of information integration to the two types of inferences identified earlier in the discussion of Schank's theory of conceptual dependancy as "forward-looking" and backward-looking". It seems possible that the two different inferencing tasks may require differing integrating processes which have been identified by Luria, and Das and his associates.

Cognitive Synthesis and Reading Research. A survey of reading research revealed two studies which have directly related cognitive synthesis and reading have been carried out by Latham (1973) who worked with college undergraduates, and Leong (1974) who compared able and disabled male grade four readers. Although these two researchers used divergent research techniques, they both concluded that cognitive synthesis was a significant factor in reading.

Based on the assumptions that identification of verbal concepts and their synthesis into language segments proceed at the same time, and that this synthesizing process is hierarchical in nature (i.e. lower units are synthesized into higher order units), Latham (1973) explored selected patterns of chunking the visual printed stimuli as a method for exploring the relationship of simultaneous synthesis of words and comprehension of written language with 325 undergraduate students. In order to classify the subjects as simultaneous or successive synthesizers, Latham used a modified Bousfield test of recall. By classifying his subjects in this manner, he was forced to use two either-or categories. Each subject was categorized as either a successive or simultaneous synthesizer. Such a classification system does not reflect the theoretical position expressed by Luria that both types of synthesis is available to the subject in varying degrees at the same time. To test the various chunking patterns of the visual stimuli, Latham used a computer screen so that the reader was forced to work with the predetermined chunks. This of course created an unnatural reading situation since the preceding and subsequent parts of the text were not available to the reader as in a normal reading situation.

Latham found a significant positive relationship between a subject's knowledge of verbal concepts as measured by a standardized vocabulary test, and the comprehension of written material as measured by a standardized reading comprehension test. However, he also found that although more than three-quarters of the "poor" readers had vocabulary scores similar to the "good" readers, the former's comprehension scores were significantly lower. He concluded "that while knowledge of verbal concepts is necessary for the comprehension of written language, it is not a sufficient condition to ensure that such comprehension will occur". (Latham, 1973, pp.367-368). Latham also concluded that the ability to synthesize simultaneously appeared to be significantly related to reading comprehension.

Latham's research technique, chunking of the visual input, by its very nature and its relationship to grammar was tied to the sentence, and did not allow for the exploration of relationships that may exist between sentences, or beyond two or more sentences. Luria's concept of simultaneous synthesis appears to include such relationships which seem to be essential to discourse comprehension.

Leong (1974) carried out his study of the relationships of cognitive synthesis, dichotic listening, and general reading ability with 116 grade four male students (58 retarded in reading achievement by two and a half or more years, and 58 above average readers equated in age, sex, and general ability). From the results of the dichotic listening tasks, Leong found that both the experimental (the disabled readers) and the control group (the able readers) performed better on the right ear which had been hypothesized based on previous research. He also found that significantly higher scores were achieved by the control group, and from this concluded that this was evidence of a lag in functional cerebral development of the disabled reader.

The simultaneous and successive modes of information processing were also examined with these subjects using six tests from the Das battery (Raven's progressive matrices, Figure Copying, Memory for Design, Cross-modal Coding, Visual short term memory, and Auditory serial recall), and two tests from the Illinois Tests of Psycholinguistic Abilities (ITPA Visual Sequential Memory subtest, and ITPA Auditory Sequential Memory subtest). From his factor analyses, Leong confirmed the Das distinction of simultaneous (spatial), and successive (temporal) modes of integration. Although the control and experimental groups had been equated for age, sex, and general ability, the analyses indicated significant differences between the performance of the two groups in favour of the able readers on the tasks. Although there were similarities in the loadings of the tasks on simultaneous and successive factors, these loadings were not identical for the two groups. This led Leong (1974, p.339) to draw attention "to individual differences inherent in both tasks and children." He (1974, p.337) also suggested that the hierarchical-parallel agrument advanced by Das was irreleveant and concluded that "psychologically what is simultaneous and what is successive are relative within the matrix postulated." Leong's interpretation appears to follow more closely with the original propositions put forth by Luria. His interpretation allows for either or both types of synthesis to play a part in sensory processing, mnestic processing, and the mnestic-intellectual processing.

More recently Kirby and Das (1977, in press) have reported a study which attempted to explore the relationships between these two modes of cognitive synthesis and school achievement in reading (vocabulary and comprehension). The subjects for this study were 104 boys in fourth grade in regular, urban schools. The Das battery of tests of cognitive synthesis was administered to the subjects, and the data gathered was submitted to statistical analyses with the performance scores of the children in reading achievement (vocabulary and comprehension) as measured by the Gates-MacGinitic Reading Test, and the children's IQ (verbal and non-verbal) as measured by the Lorge-Thorndike Intelligence Test.

The findings from the analyses of the cognitive synthesis data were consistent in identifying three identifiable factors (successive synthesis, simultaneous synthesis, and speed) reported in previous research. To relate the children's performance in cognitive synthesis with reading achievement, and IQ performance,"a double median split was performed upon the 104 subjects on the basis of their simultaneous and successive factor scores." Thus, four cognitive synthesis groups were formed: (1) subjects high on both simultaneous and successive synthesis (n=29); (2) high on simultaneous,low on successive (n=23);(3)low on simultaneous, high on successive (n=23); and (4) subjects low on both simultaneous and successive synthesis (n=29). Then four 2 x 2 analyses of variance were carried out for reading achievement (vocabulary and comprehension), and IQ (verbal and non-verbal). For all four analyses they found there were significant main effects due to simultaneous and successive synthesis. In each case no significant interactions were reported.

From their findings these researchers concluded that "level of simultaneous and successive processing is related to all four measures of school achievement." They went on to point out that "proficiency with both forms of processing is necessary, but neither, by itself, is sufficient for high achievement."

The findings were seen as support for differentiating the information integration model (Das, Kirby and Jarman, 1975) from Jensen's theory of Level I (Memory) and Levell II (Reasoning) abilities. In his work, Jensen strongly stresses that there is a hierarchical relationship between Level I (Memory) and Level II (Reasoning). The Kirby-Das study clearly indicated that successive and simultaneous synthesis were not hierarchical in their relationship.

The two types of synthesis, simultaneous (spatial) and successive (temporal), appear to be useful perspectives from which to explore the cognitive processing of selected grade four students when required to make forward and backward-looking inferences. Support for the psychological reality of the two types of synthesis in reading have been drawn from the research of Latham, Leong, and Kirby and Das. The stability of the findings related to the tasks used in the Das battery has suggested that they could be used to operationalize the two kinds of synthesis for comparative purposes. The research design used by Kirby and Das provides an analytic method for relating the cognitive synthesis performance to the subjects' performances on the tasks related to forward and backward inferences. The actual selection of the cognitive synthesis tests and their description will be dealt with in Chapter 3 in the section on instrumentation and data collection procedures.

INTROSPECTIVE-RETROSPECTIVE INTERVIEW AS A RESEARCH TECHNIQUE

In a comprehensive review of the introspective-retrospective interview as a research technique, Marland (1977) pointed out that the procedure has been used in a number of fields of inquiry to tap data that would otherwise be inaccessible. Some of these research areas have included (1) counsellor training, (2) processes of medical inquiry, and (3) teaching and learning. Throughout the annals of "scientific" research, investigators have tended to be either very supportive of, or stongly opposed to the use of this technique. Recently Radford (1974) has maintained that introspection is a defensible research tool in the behavioral sciences. Marland's (1977) study of teacher's interactive thought processes is an example of the renaissance of introspection-retrospection as a research technique. In the remainder of this section, the use of introspection-retrospection in reading research will be reviewed.

As in other research areas, the use of introspective and retrospective interview techniques to explore subjects' cognitive processes while reading has had its proponents (Huey, 1908; Gray, 1958; Strang, 1965), and its opponents (Neisser, 1967; Simons, 1972). A review of this type of research has revealed that while the methods have not been used extensively in reading research, they have provided significant insights into the reading process (Strang, 1967). These methods have been used with adults to provide insights into (1) the conscious thought processes of college students when answering questions based on previously read selections (Swain, 1953), and (2) the use of context to obtain meaning for unknown words (Ames, 1965). The techniques have been used also with high school students to explore (1) the thought processes involved in completing cloze exercises (Jenkinson, 1957), (2) interpretive responses to reading poetry (Letton, 1958),

(3) interpretive responses when reading a short story (Rogers, 1965), and (4) reading processes of severely retarded readers (Cafone, 1966). As well, introspective and retrospective interview techniques have been utilized successfully by researchers studying the elementary school child's cognitive processes in selected reading tasks. Insights have been provided into (1) grade six children's interpretive responses when reading (Piekarz, 1954), (2) the influence of selected types of material on reading processes (Fareed, 1971), and (3) the use of context by maturing readers in grades four, six, and eight to obtain meaning for unfamiliar words (Laing, 1974). This last study has shown that the technique could be profitably used with grade four children.

Simons (1972) has raised the perennial question of whether the verbalizations of subjects really reflect the underlying cognitive processes. He questions whether the reader can really be aware of these processes since they occur with such rapidity that they may not be available for conscious consideration. A similar point has been raised by Neisser (1968) who has suggested that the language responses of the subjects belie the complexity of thinking.

According to Johnson (1972) introspection as a way to explore psychological activities developed during the nineteenth century in Germany under the guidance of Wundt and his colleagues. Wundt believed that language was a product of thought and therefore reflected thinking. In a similar vein, Strang (1970, p.19) maintained that introspective-retrospective reports gave "the closest available description of the reading process". She (Strang, 1970, p.19) also pointed out that:

> If we could see the pupil's mind from the inside at the moment of understanding the meaning of the selection he is reading, we would know more precisely how he comprehends and interprets what he reads. Persons of different ages and abilities, with encouragement and practice, are able to recall and verbalize thoughts and feelings that occur to them as they read; in other words they can describe their own learning experiences.

Huey (1908, p.150) recognized the imperfections of the technique, but alleged that "careful introspection of actual reading" was "probably the sanest though imperfect test" of whether cognitive processes related to reading were simultaneous or successive. Strang (1962) has suggested that in areas where little actual knowledge is presently available the introspective and retrospective techniques may prove useful for giving direction for further research. Two desirable characteristics of these interview techniques have been identified by Wiersma (1969, p.275) as flexibility and opportunity to probe the responses of the subjects.

At the present time, little knowledge of inferencing and the cognitive processes related to inferencing by maturing readers is available. Thus, exploratory methods appear to be defensible, and may provide direction and a basis for further research.

SUMMARY: FOCUS OF THE PRESENT STUDY

That reading the printed page is a language task which is cognitively directed is currently accepted by several prominent writers in the field of reading (Smith 1975; Geyer and Kolers, 1974; Gibson, 1972). In an attempt to develop a theoretical framework for the present study, this chapter has drawn from three fields of research outside reading which have focused on languaging and cognizing, namely, psycholinguistics, natural language processing models of information processing, and the neuropsychological studies of Luria. The literature and research reviewed has been presented within the theoretical framework established by Ruddell (1969, 1972, 1974) in his "Systems of Communication" model.

Reading comprehension is the general facet of reading with which the present study is concerned. In Chapter 1, reading comprehension was defined as "a complex of processes involved in bringing meaning to the printed page and interacting with the written message in order to communicate with the author." The first part of this definition can be clearly linked with Ruddell's "Aspects of Interpretation" which is based on the reader's interaction with the written message. The components of the written message with which the reader interacts has been described in terms of Ruddell's "Aspects of Meaning". Both are necessary for understanding the author's message. In order for this communication to take place, the reader must, in Jenkinson's terms, remain "loyal to the given." Thus, in the present study comprehension is viewed as a constructive-interpretive process.

Support for the drawing of inferences as an important component of reading comprehension has been drawn from research, and theoretical statements of leaders in the reading field. As well, the importance of inferencing has been understood by the recent works in the language-related areas of psycholinguistics, and information processing within the parameters of the natural language user model. Inference is concerned with the unstated information that is important for bridging or linking the stated information into an understandable unit. Two types of inferences have been identified from selected information processing literature. These are backward-looking inferences and forward-looking inferences. The former kind of inference requires the reader to supply the information which the writer has assumed but has not stated in order to "tie together" the episodes of the story. This type of inference seems to depend heavily on the readers knowledge-of-the-world, and therefore, the task would appear to be more constructive in nature. In contrast, the latter kind of inference requires the linking of specifically stated bits of information in order to infer new information and so enhance understanding. Success in this type of task would seem to require interpretation within the constraints of the given text. Does this difference reflected in these two types of inference affect the cognitive processing strategies of maturing readers? If so, how? This is a major concern of the present study.

Although the general role of inference has been fairly well established in sentence research, the present study will focus on written discourse. Support for the need of discourse research has been found in the recent psycholinguistic studies. Much of this research has focused on conversational discourse. However, more studies are now being reported that have dealt with written language. In addition, support has been drawn from the information processing research which has focused on natural language use extended beyond the sentence level. This study will use multi-sentential, multi-paragraph written discourse as stimulus. Such a task seems to reflect more closely the kind of reading expected of children in the regular classroom.

Since inferencing and the understanding of written language depends upon the cognitive involvement of the reader with the ideas expressed by the writer and represented in the graphic display of print, an attempt will be made to relate the drawing of inferences with one type of cognitive activity identified as synthesis. Support for the psychological reality of cognitive synthesis has been found in the studies of Luria, Das, and others. Two types of cognitive synthesis have been identified with a remarkable degree of stability. These involve the spatial integration of incoming information, and the temporal integration of such information. These two types of synthesis have been operationalized by Das in a battery of tests. Selected tasks from this battery will be used to explore the relationship between drawing forward, and backward-looking inferences and spatial and temporal information integration. The research design used by Kirby and Das has been reflected in the present study.

Introspection and retrospection by the readers will be used in order to probe the cognitive activities used by students when required to inference. While recognizing the limits of such techniques, support has been developed for their use in this study.

In brief, the present study views inference as an important constructive-interpretive element of the integrative skills required by the reader in the interpretation of written narrative discourse. This study is an exploratory attempt to relate the drawing of inferences and cognitive synthesis within Ruddell's theoretical framework of reading comprehension required by written narrative discourse.

CHAPTER 3

METHODS OF INVESTIGATION AND RESEARCH PROCEDURES

This chapter describes the design, and the investigative strategies employed in the study. The research methods, the selection and description of the sample, the research instruments and the procedures for data collection, and the techniques used in the treatment of the data are presented. Reasons for the selection of test instruments are outlined.

DESIGN

The major purpose of this study was to investigate the relationship of drawing inferences and cognitive synthesis for selected fourth grade students. To achieve this purpose, selected tests of cognitive synthesis, and reading comprehension tasks involving introspection and retrospection were used. The study was conducted in three phases.

The first phase involved the analyses of selected instructional reading materials to determine whether grade four students were required to draw inferences as part of their reading program. More specifically, the analyses were to determine whether both forward-looking and backward-looking inferences were included in questions demanding the children to draw inferences. The materials selected were drawn from those approved for use specifically in the province of Alberta. However, it should be noted, that the same materials are approved for use in the majority of other Canadian provinces as well. The report of this phase of the study is presented in Chapter four.

The second phase of the study involved the simultaneous development of reading tasks, and pilot studies to determine the data gathering procedures. The reading tasks were designed with selections of continuous discourse, and the two types of inference questions for use in the structured introspective-retrospective interviews. This, too, is reported in Chapter four.

The third and final stage of this study consisted of the data collection with the purposively drawn sample of grade four students. This involved two sessions with each of the students. The first was a group session in which the selected students from each of the schools used in the sample completed the tests of cognitive synthesis. The session lasted for about one hour, and was repeated in each of the five schools. The second session was an individual introspective-retrospective interview session involving the completion of the reading tasks. These interviews were taped with a cassette tape recorder, and later transcribed into typed protocols. Analyses were made of the data collected, and these form the major part of the remainder of this dissertation.

SAMPLE

The focus of the present study was on the fourth grade reader who appears to have adequate vocabulary development, but who is less proficient in comprehension. For this study the subjects had to have achieved a vocabulary standing of the 70th percentile or better, and a comprehension standing of the 55th percentile less on the Stanford Reading Achievement Test (1964). In order to assess the relationship of of inference drawing and cognitive synthesis, and to explore the strategies used by such students, the sample of fourth grade students for this study was purposively drawn (Downie & Heath, 1974).

Fourth grade students were selected for three reasons. The first was related to their level of cognitive development. Piaget (1957,1967) has suggested that one of the major distinguishing events in the history of a child's cognitive development is the acquisition of operations. He (Piaget, 1957, p.8) has defined operations as "actions which are internalized, reversible, and coordinated into systems characterized by laws which apply to the system as a whole." One of the critical periods in which operations play an important role has been identified as the concrete operational stage (Piaget, 1967). This stage extends from ages seven to eleven. Children in grade four would appear to be within this stage, rather than in either of the transition stages (i.e. between the pre- and concrete operations, or between the concrete and formal operations). The internalization and related aspects of reversibility and coordination of relationships in time and space would appear to be established by the fourth grade level. The foregoing aspects of operations would appear to be significant factors in successful drawing of inferences. Thus, children in grade four would appear to be able to cope with the reading tasks in this study. The second reason for the selection of fourth grade students arose from the fact that the task of drawing inferences has been identified as a skill that is part of the fourth grade reading program. Thirdly, the research technique of introspective-retrospective interviews has been used successfully with grade four children (Laing, 1974).

The total sample for the study comprised 40 students. Twenty of these students were designated as less proficient in reading comprehension, and twenty were considered very proficient. The sample was drawn from five suburban schools in the Edmonton Public School System. These schools were selected by the administrators in central office, and were identified by the respective principals as serving middle to upper-middle class areas of the city. The total grade four population in these five schools at the time of sampling was 367 students. A breakdown according to school is presented in Table 3.1.

Table 3.1 POPULATION SAMPLED: STUDENT DISTRIBUTION ACCORDING TO SCHOOL

School	Number of Grade Four Students
A	103
B	89
C	85
D	66
E	24
Total 5	367

In order to identify the students as less proficient or very proficient readers, school approval was obtained to have access to the students' personal record files. From these the following information was gathered: estimates of levels of achievement in vocabulary development, and reading comprehension according to a system admistered standardized reading achievement test (i.e. The Stanford Reading Achievement Test, 1964), and an estimate of achievement potential (non-verbal IQ from the Canadian Cognitive Abilities Test, 1974).

These tests had been administered at the close of the 1975-76 school year when the students were completing grade three. From these results forty-five students were identified as having adequate vocabulary development, but as being less proficient in reading comprehension.

Since three months of school had intervened between the administration of the standardized tests, and the selection of the sample, teacher judgement was used to confirm whether or not subjects were encountering difficulty with reading comprehension. For each school, a list of the identified less proficient readers was submitted to the current classroom teachers in order to identify (1) those students who were still having difficulty with reading comprehension, and (2) those students who spoke English as a second language. English as a second language was considered a confounding factor, and therefore such students were not considered for this study. The classroom teachers confirmed that the students identified were having difficulty in reading comprehension, and identified seven of the students for whom English as a second language was confounding factor. There remained thirty-eight students who met the criteria established for less proficient readers in this study. From these thirty-eight students, ten boys and ten girls were selected on the basis of similarity on non-verbal IQ scores. The less proficient group of students for the present study consisted of twenty students, ten boys and ten girls with adequate vocabulary development, but less proficient comprehension, and comparable achievement potential according to non-verbal IQ scores. The non-verbal IQ scores were used since they were believed to provide a less biased estimate of potential. Students who are less proficient in reading comprehension could be penalized on the tasks presented in the verbal IQ sections of a group administered IQ test, since efficient reading is required to complete the items.

Having identified the less proficient readers, the very proficient readers were drawn to complete the sample. Twenty students, ten boys and ten girls, who were very proficient in both vocabulary and comprehension (85th percentile or above), and who had non-verbal IQ scores comparable to less proficient readers, were selected. Thus, the total sample of the study consisted of forty selected grade four students ($N=40$). Throughout this study a capital N will represent the total sample, and a small n the sub-catgories. Subscripts will be used to identify the sub groupings. For example, n subscript 1p will represent the total less proficient group ($n_{1p}=20$). The addition of the subscript m will represent the less proficient males ($n_{1pm}=10$), and a subscript f will represent the less proficient females ($n_{1pf}=10$). Likewise, subscript vp will represent the very proficient readers ($n_{vp}=20$), and the addition of a subscript m or f will represent the very proficient males ($n_{vpm}=10$), or very proficient females ($n_{mpf}=10$) respectively. A summary of the sample is given in Table 3.2.

In order to ascertain whether the observed differences between the boys and girls, and the two levels of proficiency in reading (very proficient and less proficient) were statistically significant, the criterion data were submitted to a two way analysis of variance with main effects (A) sex, and (B) reading proficiency. The statistical treatment revealed no significant differences due to (A) sex or (B) reading proficiency for age, and non verbal IQ. Significant differences were calculated due to reading proficiency for both vocabulary

Table 3.2 SAMPLE DESCRIPTION: MEANS AND STANDARD DEVIATIONS FOR CRITERION VARIABLES

		CRITERION VARIABLES							
Reading Proficiency		NVIQ		C.A.		VOC.		COMP.	
	Sex	$\overline{X}$	(s.d)	$\overline{X}$	(s.d)	$\overline{X}$	(s.d)	$\overline{X}$	(s.d)
Less Proficient (n_{lp}=20)	Boys (n_{lpm}=10)	110.8	(9.55)	113.1	(3.38)	80.1	(8.38)	48.2	(12.89)
	Girls (n_{lpf}=10)	109.6	(9.51)	114.1	(3.32)	74.4	(4.62)	42.7	(8.64)
Very Proficient (n_{vp}=20)	Boys (n_{vpm}=10)	109.9	(9.23)	114.8	(2.30)	92.7	(2.98)	92.7	(5.68)
	Girls (n_{vpf}=10)	110.5	(8.32)	113.9	(1.97)	92.0	(4.22)	91.3	(5.36)

and reading comprehension. There was no significant difference due to sex on these variables. The results of these findings are summarized in Table 3.3.

INSTRUMENTATION AND DATA COLLECTION PROCEDURES

The data collected in this study can be divided into two general categories: data related to cognitive synthesis, and data related to reading comprehension. The following description of the instruments used, and the procedures followed in the data collection has been organized under these categories. First, the instruments and the procedures related to cognitive synthesis will be presented. This will be followed by the tasks and procedures related to inference in reading comprehension.

Cognitive Synthesis: Instruments And Procedures To Identify Subjects

As pointed out in Chapter two, the instruments used to assess the subjects' abilities in cognitive synthesis were taken from the Das Battery of Cognitive Synthesis Tests (Das, Kirby and Jarman, 1976). The instruments selected were Memory for Design Test, and Visual Short Term Memory Test. The first has been identified as a test of simultaneous synthesis, and the second as a test of successive synthesis. For a discussion of the stability with which these tests have been identified with the respective aspects of cognitive synthesis, the reader is referred to the review of the related literature in Chapter 2. Both of these tests use visual stimuli, and require graphic reproduction. Tests using the visual mode for the presentation of the stimuli

Table 3.3 TWO-WAY ANALYSIS SUMMARY TABLE: CRITERION VARIABLES BY READING PROFICIENCY (A) AND SEX(B)

1. Variable: NVIQ (Canadian Lorge-Thorndike Intelligence Test - NV - Battery)

Source	SS	df	MS	F-ratio	Prob
A	1.062	1	1.062	.013	.91
B	1.812	1	1.812	.022	.88
AB	8.062	1	8.062	.095	.76
SE	302.550	36	84.041		

2. Variable: CA (Calculated in Months as of January 31, 1977)

Source	SS	df	MS	F-ratio	Prob
A	6.687	1	6.687	.846	.36
B	1.062	1	1.062	.134	.71
AB	8.937	1	8.937	1.131	.29
SE	284.443	36	7.901		

3. Variable: Vocabulary (Stanford Reading Achievement Test- Primary II)

Source	SS	df	MS	F-ratio	Prob
A	2280.06	1	2280.06	77.036	.00*
B	102.375	1	102.375	3.458	.07
AB	62.437	1	62.437	2.109	.15
SE	1065.50	36	29.597		

4. Variable: Comprehension (Stanford Reading Achievement Test - Primary II)

Source	SS	df	MS	F-ratio	Prob
A	21669.0	1	21669.0	287.217	.00*
B	118.938	1	118.938	1.576	.22
AB	41.937	1	41.937	.555	.46
SE	2716.00	36	75.444		

* significance $\leq$ .05

were selected since reading depends on this mode. The only test from the Das Battery that assesses successive synthesis and uses the visual mode is the Visual Short Term Memory Test. This test requires the subject to recall information from memory. Therefore, in an attempt to maintain similarity in task demands, the simultaneous task selected, Memory for Design Test, also required memorial abilities.

Both tests were group administered by means of 35mm slides. These were presented with a Kodak Carousel slide projector. In each of the schools, the tests were administered in a regular classroom. The subjects were seated so that each had a clear view of the screen. No student was nearer to the screen than ten feet, and no student was more than twenty feet from the screen. A trial slide was projected on the screen to be certain each subject had a clear view.

The session began with an introduction of the investigator, and his reason for being with the students. The subjects were told that the activities they were going to do would not be used in any way to report to parents, but that their best participation was needed in order to make the project a success. In each of the schools the Visual Short Term Memory Test was administered first. This was followed by the Memory for Design Test.

Visual short term memory test: a test of successive synthesis. This test consists of the presentation of a five digit grid, inspection by the subjects, removal of the grid, presentation of a filler task, the recall of the stimuli digits on an empty grid. (See Appendix A, p.265). The total test is made up of twenty grids of five digits each.

Each subject received a test booklet made up of twenty empty grids.

Two trial grids and filler tasks were completed by the subjects before the actual test commenced. Each five digit grid was projected on a screen for five seconds. A stop watch was used to ensure accuracy of timing. During this time the subjects inspected the grid. Then the grid was removed, and immediately a slide composed of colour bars was presented. The subjects were required to name orally in unison as many colours as they could in two seconds. The colour slide was then removed, and the subjects attempted to recall on a prepared empty grid as many of the five digits as possible. These recalled digits had to be placed in the correct positions. This procedure was continued until all twenty grids had been completed.

The scoring of this task is simply the number of correctly recalled, and properly placed digits. A perfect score would be 100.

Memory for Design Test: A test of simultaneous synthesis. This test consists of the presentation of a geometric figure, inspection of the figure by the subject, and reproduction from memory of that figure by the subject. There are fifteen geometric figures in the test. (See Appendix B,p.271) . Although the test as originally conceived (Graham and Kendall, 1960) was administered individually, more recent uses of the test have been adapted for group administration through the use of slides, and a slide projector (Kirby, 1976). This latter procedure was followed in this study.

Following the completion of the Visual Short Term Memory Test, each subject was provided with a booklet of fifteen blank pages with an identification cover, a pencil, and an eraser. The subjects numbered the pages from one to fifteen. This served as a double check to see that each booklet was complete, and helped to clarify for the children that only one figure was drawn on each page of the booklet. Subjects were directed to place the booklet straight in front of them, and requested not to move the booklet from that position during the administration of the test. When the task had been described orally, the subjects were given an opportunity to ask questions for clarification.

The geometric figures were presented one at a time on slides by means of a Kodak Carousel Slide Projector. Each figure was presented for five seconds, during which time the subjects studied the figure. A stop watch was again used to ensure accuracy of timing. When the original stimulus was removed, the subjects reproduced the figure from memory on the appropriate page. Subjects were given as much time as they needed to draw each figure. This procedure was repeated for each design until all fifteen had been completed.

The subjects' reproductions were scored 0, 1, 2, or 3 according to the maintenance of relations and proportions of the original figures. The scoring guidelines used to evaluate the subjects' drawings are presented in Appendix B, p.271. The total score can range from 0 to -45, and is the sum of the scores of the fifteen individual designs. Since this score is actually an error score, the lower the score the better the performance.

Classification of Subjects According to Cognitive Synthesis Performance. This session was designed to gather data regarding the subjects' abilities on the two dimensions of cognitive synthesis identified by Luria as successive synthesis, and simultaneous synthesis. The two tests used for this purpose have been described above.

On the basis of the results of these tests, the subjects were ranked according to performance from highest to lowest. By using the median score for each ranking, the subjects were identified as high (above the median), or low (below the median) for each of the two dimensions of cognitive synthesis. Four categories were derived: (1) those subjects who ranked high on both tests (CS-HH); (2) subjects who ranked high on successive synthesis, but low on simultaneous synthesis (CS-HL); (3) subjects who ranked low on successive synthesis, but high on simultaneous synthesis (CS-LH); (4) the subjects who ranked low on both tests (CS-LL). This classification has been diagramed below in Figure 3.1.

		SIMULTANEOUS SYNTHESIS	
		high	low
SUCCESSIVE SYNTHESIS	high	CS-HH	CS-HL
	low	CS-LH	CS-LL

Figure 3.1 CATEGORIZATION OF SUBJECTS ACCORDING TO RANK ON COGNITIVE SYNTHESIS TESTS

This classification was used to analyze the data in order to explore the research questions which focused on the relationship of cognitive synthesis strategies and inference drawing in reading comprehension.

Reading Comprehension And Inference: Tasks And Procedures

Three tasks related to reading comprehension were developed by the investigator. A detailed account of their development is presented in Chapter Four. The following is a brief description of the reading-related tasks and the procedures followed in their use. The tasks include: (1) *Oral-Reading and Inference Task* (*ORIT*); (2) *Story-Recall Inference Task* (*SRIT*); (3) *Directional-Question Inference Task* (*DQIT*). These three tasks were completed individually with each of the subjects during an introspective-retrospective interview session. All responses were oral, and were taped by means of a cassette tape recorder. These recordings were later transcribed into written protocols for analyses. A general account of this interview session is given below, followed by a more detailed description of each of the three tasks.

Introspective-Retrospective Interview Session: An Overview. The individual introspective-retrospective interview with each subject was conducted by the investigator. In each of the schools the respective principals assigned a suitable room for the interview sessions. The interview sessions were scheduled so that they occurred on a Tuesday, Wednesday, or Thursday during the regular school hours. Although the rooms were not sound proof, interruptions and disturbances were minimized as much as possible amid the normal functioning of the school.

The interview sessions lasted for about 35 to 45 minutes for each subject. Each interview was conducted according to the following general format. The investigator met each subject at his or her classroom, and took the subject to the interview room. The subject was comfortably seated at a desk or table with the investigator seated beside him. A Sanyo Cassette tape recorder had been placed on the table ready for use prior to the subject's arrival. Each interview began with a discussion of the reason for the use of the tape recorder, and a request for the subject to identify himself, his grade, and school on the tape. This was followed by a discussion of what the subject liked to do out of school, and in school. At this point the introductory discussion was played back to the subject. This procedure helped to develop a positive rapport between the student and investigator, and also provided an opportunity to check that the tape recorder was functioning properly.

Following the introductory activities, the three reading-related tasks were completed in the following order: first, ORIT; second, SRIT; and finally, DQIT. These three tasks were related to a common selection of continuous narrative discourse. Following the completion of the three tasks, the subject was praised for his cooperation, and thanked for his participation in the study. A description of each of the tasks and the procedures followed is given next.

The Oral-Reading Inference Task (ORIT). This task was developed by the investigator. The subject was requested to read orally one of the two alternative multi-paragraph continuous narrative discourse selections. As he read, he was also asked to introspect and to orally report his thoughts. The alternative selections were found to be comparable on the basis of traditional readability criteria, and also on the basis of an analysis with an adaption of Rummelhart's story grammar for continuous discourse. The detailed development, and description of these selections are given in Chapter Four. The actual selections are presented in Appendix C, p.278. The selection read for this task also served as the basis of the two following tasks (SRIT, and DQIT). The selections were purposively assigned to the subjects so that an equal number of less proficient and very proficient readers attempted each selection.

In the administration of the task, the investigator first presented the subject with a brief description of inference, and the task to be completed. Then the subject and the investigator worked together through a short sample paragraph. The subject was questioned to see if he understood the procedure, and then he attempted a second short sample paragraph on his own. Upon successful completion, he was presented with one of the reading selections, and asked to read it in the same manner as the two sample paragraphs. He was informed that he would be asked some questions upon completion. The introductory comments, the sample paragraphs, and the reading selections are presented in Appendix C, pp. 278 - 293.

The subjects' responses were qualitatively analyzed. The framework of these analyses is presented in Chapter Six.

Story-Recall Inference Task (SRIT). In the literature and research on memory, the suggestion has been made that inferences are stored and recalled as part of the representation of a reading experience. This conclusion has been based largely on studies with adult subjects. This task was used in order to see whether selected grade four students generate inferences as part of their story recall.

Following the completion of the previous task (ORIT), the subject was given the opportunity to re-read silently the selection before orally retelling the story. When he had finished the silent reading, the original selection was taken away by the investigator. The subject recounted the story unaided. When he finished the investigator asked, "Is there anything else?"

The subjects' reproductions were qualitatively analyzed. The form of this analysis is presented in Chapter Six.

Directional-Question Inference Task (DQIT). Following the completion of the previous task (SRIT), the original copy of the story was returned to the subject. The investigator solicited the subject's cooperation in answering some questions. The subject was told that he could refer to the story if he wished when answering the questions.

The task comprised ten inference questions developed by the investigator and based on the reading selections. The first five questions were identified with forward-looking inferences, and the last five questions were identified with backward-looking inferences. The questions were presented orally by the investigator one at a time. Each subject received the questions in the same order. After the subject responded to the original question, the investigator asked, 'Why do you think so?", or 'What makes you think that?' If in his explanation the subject did not refer to the story content, the investigator asked, 'Was there anything in the story that made you think so?" If clarification was needed, questions such as 'What do you mean by....?" were also asked.

The subjects' initial responses to these inference questions were scored on a descending five point scale depending upon the adequacy of the response, and whether the inference was supported by the content of the selection. A perfect score would be 50 for all ten questions; or 25 for each of the forward and backward inference questions. The responses and related explanations were qualitatively analyzed for recurring strategies used by the subjects in order to answer the questions.

DATA TREATMENT

The data collected for the cognitive synthesis tests were used to identify the subjects as high successive-high simultaneous synthesizers, high successive-low simultaneous synthesizers, low successive-high simultaneous synthesizers, or low successive-low simultaneous synthesizers. This classification was then used as a framework for considering the data from the reading-related tasks.

In analyzing the collected data, both quantitative (achievement) and qualitative (process) aspects were considered. The techniques and procedures followed in the analyses are detailed in Chapters 5 and 6.

Where appropriate, statistical procedures were used with selected data, these techniques were performed on computer programs available at the University of Alberta. Included in these analyses were the following:

1. A chi square test was employed to determine whether there were any significant differences in the distribution of the subjects across the four cognitive synthesis groups in terms of their reading proficiency.
2. Two-way analysis of variance was used to test for significant interaction and main effects due to:
    - (a) reading proficiency and sex on the scores of the two synthesis tests;
    - (b) successive and simultaneous synthesis on the criterion variables (non-verbal IQ, chronological age, reading vocabulary, reading comprehension)
    - (c) successive and simultaneous synthesis on the subjects performance scores on the reading-related inference tasks of ORIT, SRIT, and DQIT
3. A Signs Test was utilized to test whether there were significant differences within groups in terms of the number of, and amount of supported forward-looking and backward-looking inferences on ORIT, SRIT, and DQIT for:
    - (a) cognitive synthesis groups
    - (b) reading proficiency levels

3. Independent t-tests were employed to test for significant differences between the very proficient and less proficient readers on their performance scores for the reading-related inference tasks of ORIT, SRIT, and DQIT.

5. Pearsons Product Moment correlations were calculated to determine that extent and the significance of the relationships among selected variables (criterion variables, cognitive synthesis scores, and performance scores on the reading related inference tasks).

SUMMARY

Introspective-retrospective interview techniques were used in this study for the purpose of exploring inference drawing in reading comprehension. As well, cognitive synthesis tests were administered to selected grade four subjects. This chapter has given an overview of the design, and investigative strategies used in the study. A description of the following has been provided: (1) the research methods used, (2) the selection and description of the sample, (3) a brief description of the research instruments, and the data collection procedure, and (4) an overview of the data treatment techniques in order to answer the research questions.

CHAPTER 4

DEVELOPMENT OF READING-RELATED TASKS

The reading related tasks, described briefly in Chapter 3 were developed by the investigator. These tasks were: (1) Oral-Reading and Inference Task (ORIT), (2) Story-Recall Inference Task (SRIT), and (3) Directional-Question Inference Task (DQIT). This chapter records the development of the materials and procedures used in these tasks. First, the investigator's preliminary analyses of selected instructional reading materials will be discussed. Then the results of two pilot studies will be reported. Finally, the actual narrative discourse selections used in the major study will be described.

ANALYSES OF INSTRUCTIONAL MATERIALS

Once forward and backward-looking inferences had been identified in the research literature as aspects of inference that merited investigation with maturing readers, instructional reading materials were analyzed to determine whether the two types of inference were found in currently used reading programs. Since the investigation focused on fourth grade subjects, materials were selected for those designated by the publishers as appropriate for the fourth grade. The definitions of forward and backward inferences as given in Chapter 1, page 6, were used to guide these analyses.

Selection and Analyses

There is at present a plethora of instructional reading materials on the market. In order to narrow the scope for selection, only texts presently in use in the province of Alberta, on either an approved or piloted basis, were considered. One set of instructional materials was selected from each of these categories. The choice was guided by the following considerations: (1) the materials stated the teaching of inference as part of the instructional goals, (2) they were considered typical of the materials currently in use, and (3) the materials were Canadian produced. The final consideration gave added assurance that these materials would be used in the other Canadian provinces.

Materials Analyzed. In this phase of study, four representative samples of materials were analyzed. These were:

(1) Young Canada Reader (4) (Baily, 1961)
(2) Reading Progress Book (4) (Quick, 1961)
(3) People Like Me (4) (Thorn and Richmond, 1972)
(4) Comprehension Strategies I (Thorn and Richmond, 1972)

Procedures. Selections (1) and (3) are the instructional anthologies of stories. The inference questions analyzed from these materials were found in the accompanying teacher's manuals. For these texts, five selections were randomly sampled from near the beginning, the middle, and the end of each of the respective texts.

Selections (2) and (4) are materials developed for specific instruction in identified comprehension skills. All prose selections identified in the accompanying teacher's manuals as inferencing were analyzed. The presentation formats are quite different in these two texts. In Reading Progress Book (4), the prose selections were about one page in length, and totalled fourteen in number. On the other hand, in Comprehension Strategies I, only two stories were specified for inference instruction. However, the first story was six pages long, and was subdivided into seven parts, each sub-division was followed by a number of inference questions. The second story was seven pages in length, and again divided in seven parts, each followed by a number of inference questions. As a result, although the formats differ markedly, the total number of questions analyzed was quite similar for the two series.

Findings. Having selected the materials, and the specific lessons, the investigator classified the inferences demanded by the questions in the instructional material as forward, or backward in nature. The results of this exercise have been summarized below in Table 4.1.

Table 4.1 KINDS OF INFERENCE QUESTIONS IDENTIFIED IN SELECTED INSTRUCTIONAL MATERIALS

Instructional Text	Number of Story Exercises	Total Number of Questions	Number of FLI*	Number of BLI**	Total Number of Inference Questions
Young Canada Reader (4)	5	120	19	6	25
Reading Progress Book 4	14	63	37	21	58
People Like Me (4)	5	56	11	9	20
Comprehension Strategies I	2	36	23	13	36
Totals	26	275	90	49	139

*Forward-looking inference **Backward-looking inference

From these analyses it was concluded that both forward and backward looking inferences were found in these instructional materials. Grade four children using these materials would have to cope with both kinds of inference. The forward-looking inferences appeared to outnumber the backward-looking inferences by nearly two to one.

Reliability of Inference Classification

In order to check the reliability of the investigator's classification of the inference questions found in the instructional materials, a random sample of eight exercises was reclassified by two independent judges. The procedures for determining the degree of agreement was based on the work of Squire (1964) who utilized a formula earlier reported by Loban (1949) and Lewin (1947). This same procedure has been used by Arrington (1932), Fiefel and Lorge (1950), and Laing (1974) to determine inter-rater reliability. The reputability of the procedure appears well established in the research literature. The formula used is given below:

$$\text{reliability coefficient} = \frac{2 \times \text{sum of agreement}}{\text{sum of checked items}}$$

Following the procedures outlined by Squire (1964), two judges independently classified the inference questions from the eight selected exercises as forward or backward on the basis of the investigator's definitions. The level of agreement as expressed by the reliability coefficients between the investigator and each of the judges, and between the two judges is given in Table 4.2.

While the level of agreement for the forward-looking inferences was relatively high, when compared with previous studies, the degree of agreement on backward-looking inferences was considerably lower in the case of Judge 1. According to Loban (1949), a low degree of agreement may result from either vague definitions of categories, or too fine a discrimination between categories. Again following the

Table 4.2 INDEPENDENT COEFFICIENTS OF AGREEMENT FOR TWO TYPES OF INFERENCE

	FLI*	BLI**	Total
I and J_1	1.00	.50	.77
I and J_2	.93	.83	.89
J_1 and J_2	.93	.42	.69

*forward-looking inference **backward-looking inference

I = Investigator J_1 = Judge 1 J_2 = Judge 2

procedures set forth by Squire (1964), a conference was held with the two judges three weeks after the initial classification sessions to discuss and clarify the definitions of the categories.

Following the conference and re-classification of the questions, revised coefficients of agreement were determined. The findings confirmed a misunderstanding between the Investigator and Judge 1 on the definition of backward-looking inferences for the initial classification. From the discussion with the judges, it was concluded that the concept of backward-looking inference reflected "on-line" computer processing. However, when inference questions are placed at the end of the story, as is often the format in prepared elementary reading materials, the backward-looking inferences were more easily confused with forward-looking inferences, since all the information provided by the story is then available to answer the question. The revised coefficients of agreement are provided in Table 4.3.

Table 4.3 REVISED COEFFICIENTS OF AGREEMENT AFTER CONFERENCE

	FLI	BLI	Total Inference
1 and J_1	1.00	.83	.92
1 and J_2	1.00	.92	.96
J_1 and J_2	1.00	.83	.92

With overall reliability of either .92 or .96, and the lowest reliability coefficient at .83, the reliability of the investigator's classification of backward and forward-looking inferences was deemed satisfactory.

CONSTRUCTION OF READING SELECTIONS AND TWO PILOT STUDIES

As soon as the two types of inference had been clearly established in the instructional materials for fourth grade children, available comprehension tests were reviewed. No standardized test was found to be suitable for the purposes of the present study. So test selections had to be developed. This development was carried out in three stages. The first involved the development of nine reading selections and inference questions. Next a preliminary pilot study was designed to make procedural decisions regarding data collection. Finally, the major pilot study was carried out to refine data collection procedures, and finalize the choice of narrative selections for use in the study.

Initial Composing of Potential Stories

In order that the reading selections would reflect classroom expectations, the narrative selections were patterned after the stories in the Reading Progress Book 4 (Quick, 1961). In an attempt to ensure that the materials were not familiar to the students, character, setting, and plot modifications were made. In some cases information had to be added or deleted in order to generate sufficient inference questions. Since one purpose of the study was to consider inferencing while reading continuous discourse, the selections developed were of a multi-paragraph format.

Each story was checked with the "Dale-Chall Readability Formula" (Dale and Chall, 1948; Koenke 1971) to ensure some standard of level of difficulty. In addition, each story was analyzed using a modification of Rumelhart's (1975) story grammar in order to compare the internal structure of the stories. Furthermore, the story grammar proved useful in generating backward-looking inferences. A more detailed account of these analyses is given in a later section of this chapter that deals specifically with the description of the two narrative selections chosen for the major study. Although at the outset nine stories were created, the final selection was made from only six. On the basis of the previously mentioned analyses, the story length, and the ability to generate appropriate inferences two stories were deleted prior to piloting. A third was deleted as a result of findings from the preliminary pilot.

Initially the inference questions for each story were framed in both multiple choice format, and regular question format. A decision was required as to which format would provide the most appropriate data. As well, decisions had to be made regarding the subject's response mode. Would oral or written responses prove more insightful? In order to resolve these questions a preliminary pilot study was carried out.

Preliminary Pilot Study

This preliminary piloting of the reading selections was designed to determine the suitability of question format, and subject response mode for generating data.

Subjects and Procedures. The students participating in this early piloting were from all three upper elementary grades, four, five, and six. Six students who were designated by their teachers as having average reading ability took part. All were from the same suburban school. This stage of piloting was carried out during the week of October 1 to 5, 1976.

The reading tasks were administered individually. Each subject read three of the selections, and answered the accompanying inference questions for each story. For two of the readings, each subject responded to the questions in the written mode. One story was followed by regular questions, and one story was followed by multiple choice questions. For the third selection, the investigator presented the questions orally, and the subject responded orally. In this last instance, both the regular questions and the multiple choice questions were used.

Findings. From this preliminary piloting, it was found that written responses to the regular questions was very time consuming for even grade six students. The average time spent per story with the regular question format and the written response mode was fifteen minutes. The grade four subjects tired, and their attention wandered. In addition, this response mode did not provide an opportunity to check on the meaning of a subject's responses when the response lacked clarity. Further, no opportunity was afforded for exploring the strategies the subjects used to arrive at his answer. While the multiple choice question format in the written response mode required about one-third that of written responses to regular questions, there still was no opportunity to probe for cognitive strategies. Further, in some of the subject's responses to the orally presented multiple choice questions, it became clear that there were instances when the student felt there was no acceptable choice. When questioned, their responses indicated quite different cognitive structures and strategies from those assumed by the investigator when creating the questions.

Selection of Response Mode and Question Format. On the basis of these observations, the investigator decided to use the regular questions and the oral response mode. In this way a more profitable use of the subjects' time seemed possible. The problem of attention was lessened, and the opportunity to probe provided more appropriate data on how selected children draw inferences. As well as providing direction for procedural decisions, this preliminary work also provided useful insights into the appropriateness of the inference questions designed by the investigator. In some cases, acceptable responses were made by the subjects without any inference at all. In addition, one story was consistently identified by the students as uninteresting, so it was deleted. This left six selections from which to chose the materials for the reading related tasks in the major study. In order to select these stories, and to refine data collection procedures for both the inferencing tasks, and the cognitive synthesis tasks, a pilot study was conducted between November 15, 1977 and December 10, 1977.

Main Pilot Study

Following the initial piloting, revisions were made in the remaining six stories. In addition, the questions were modified, and some were replaced. Then the second (main) pilot study was carried out.

The purposes of this second pilot study were to (1) select the narrative stories for use in the major study, and (2) develop proficiency in administering (a) the reading-related tasks in the introspective-retrospective interview setting, and (b) the cognitive synthesis tasks.

Subjects and Procedures.

The students who participated in this phase of the study were selected from grade four classrooms in three suburban schools of the Edmonton Separate School System. Two classes (N=44) took part in refining the administrative procedures for the cognitive synthesis tasks. One class (N=24) assisted in determining the appropriateness of the stories. This was done by having the children indicate by a show of hands their preferences. As well, nine students who met the criteria for the very proficient and less proficient readers took part in refining the procedures used in the introspective-retrospective interviews.

Selection of Stories for Major Study.

In order to select the narrative stories for use in the major study, the six stories were identified by letters A to F and ranked according to (1) student achievement on the inference questions (mean, and standard deviation), and (2) student interest rating. A list of the six stories according to title and general plot statement with mean performance scores, standard deviations, and interest rankings is provided in Table 4.4.

Stories A, D, and F were rejected because of the low mean achieve-

Table 4.4 SUMMARY OF STUDENT PERFORMANCE AND INTEREST RATING FOR SIX NARRATIVE STORIES

Title	Plot	Mean (/30)	Standard Deviation	Ranking by Student Preference
A. Settling In a Free Land	A negro family escapes slavery and settles in Upper Canada in early 1800's.	14.75	5.37	6
B. Scotty Becomes a Hero	A pet dog rescues a sleeping family from their burning home	18.00	5.42	2
C. Night Noises	The experience of two children left alone in their summer cottage for an evening.	23.25	4.18	1
D. Making a Decision	A family of birds decision to move their home when the farmer decides to harvest the grain in the field.	13.75	4.73	5
E. Miss Bella's Plan	An elderly lady's attempts to save the wild animals from visiting hunters.	18.25	5.87	3
F. How To Catch a Thief	A holy man's attempt to catch a thief who stole a gold watch.	14.16	4.32	4

ment scores, and the lack of interest expressed by the students on these stories. Although story C was ranked as the most interesting by the students, it was rejected because two students achieved perfect scores, the mean was rather high, and the standard deviation was the smallest of all the six stories. Thus, stories B and E, "Scottie Becomes A Hero", and "Miss Bella's Plan" respectively, were selected as the stimulus narrative stories for the reading related tasks in the major study. These stories are described in detail in the next section of this chapter.

Other Decisions Arising out of the Pilot Study. As well as providing data for the basis of the story selection, several other decisions were made as a result of this phase of the study.

The forward and backward inference questions were refined. Those questions which all students answered correctly were eliminated, as were those which no student was able to answer. In several instances, the wording of the inference questions was modified for greater clarity.

It was found that the time required for the administration of the cognitive synthesis tasks was about one hour. The introspective-retrospective interview sessions were about forty-five minutes in length. Thus, each subject would be taken from his classroom studies for about one hour and forty-five minutes.

NARRATIVE DISCOURSE SELECTIONS USED WITH ORIT, SRIT, AND DQIT IN THE MAJOR STUDY

Based on the data from the main pilot study, the two selections chosen from use in the study were "Scotty Becomes a Hero", and "Miss Bella's Plan." These narrative selections were developed by the investigator. Detailed analyses of these selections are presented in this section.

To assess the comparability of the two narrative selections, the stories were submitted to both readability and story grammar analyses. The former provided bases in terms of what have been described as surface style elements (Meyer, 1975). The latter provided insights into each selection's story components, and the relationships and organization of these story components in order to convey meaning. This has been referred to as the story's internal structure (Rumelhart, 1975). By using both types of analyses, the investigator was able to consider the comparability of the two stories at both the surface and internal levels.

Comparative Readability Analyses

The complexity of the concept of readability and the general inadequacies of currently available formulae as predictors is generally recognized. Although the predictive value of such formulae may be suspect in terms of actual reader difficulty, since they account primarily for surface factors of style, and do not consider important reader variables such as motivation, interest, and background experiences, Klare (1974) has indicated that the formulae can serve as useful tools in assessing the comparability of materials in terms of the style elements considered.

Formula Used. For the readability analyses of the two narrative selections, the Dale-Chall Formula (Dale, Chall, 1948) was chosen. This formula has been identified as more appropriate for assessing upper elementary materials (Chall, 1958). In addition, it takes into consideration not only word count but also familiarity of the vocabulary.

As well, both number and complexity of sentences are accounted for in the formula's calculations. The results of the analyses with the Dale-Chall Formula indicated that although differences did exist in terms of familiarity of vocabulary, number of sentences, and sentence length, the overall assessment was appropriate for use at the fourth grade level. A summary of the results is presented in Table 4.5.

Table 4.5 READABILITY COMPARISON OF NARRATIVE SELECTIONS

Readability Factor	Scotty Becomes A Hero	Miss Bella's Plan
number of words	451	452
number of unfamiliar words	15	10
number of sentences	42	37
average sentence length	10.7	12.2
Average Raw Score	4.8	4.7
Corrected Grade Placement	Grade IV and Below	Grade IV and Below

In his discussion of readability, Klare (1974) has differentiated between its measurement and prediction. He (Klare, 1974, p.64) has pointed out that the latter involves the use of formulae to provide "an index of the probable difficulty for readers", and differs from the former in that "no actual participation by the reader is needed." In the present study both aspects of readability were taken into account in the selection of the narrative stories. The results of the main pilot study provided a measurement indicator of the appropriateness of the readability level of the selections. The results of the Dale-Chall formula, a predictive indicator, confirmed that the materials were appropriate for use with students in grade four.

Comparative Story Grammar Analyses

As indicated in the introduction to this section, Meyer (1975, p.8) has maintained that readability formulae tend to deal with "surface factors of prose and are not concerned with the meaning of prose and the manner in which the content is organized to convey meaning to the reader." In an attempt to compensate for this weakness, a story grammar was utilized to explore the comparability of the story components and internal structure of the two narrative selections.

Selection of Story Grammar. The seminal work of Rumelhart (1975) who devised a story grammar designed to explore the internal structure of simple narrative stories served as the base for the present analyses. Although other procedures have been used in earlier research, such approaches have dealt primarily with materials of a descriptive nature, and the structures generated have been hierarchial in nature. However, Rumelhart's grammar has been developed with a network frame, thus allowing for a greater number of alternative relationships among the story components. Also, his grammar was developed with specifically the narrative story in mind. Further, Rumelhart's grammar reflected Schank's (1975) concepts of the episodic nature of cognitive processing. Therefore, the grammar was a useful tool for generating backward-looking inferences used in the Directional-Question Inference Task (DQIT). The questions used in this task are given in Appendix C, p. 278.

Grammar Rules. Since the appearance of Rumelhart's (1975) original version of the story grammar, a growing number of studies have been reported which have used this grammar as the base for the research carried out (Thorndyke, 1975; Gentner, 1976; Mandler and Johnson, 1976). Some of these researchers have refined and modified the original grammar. The adapted grammar used in this study reflects primarily the work of Rumelhart, but has included some of the modifications suggested in the more recent studies.

The rules for the grammar used in the analyses of the narrative selections for the present study have been presented in Figure 4.1. Rumelhart's grammar was composed of eleven rules. The present analyses were based on a fourteen rule grammar. Nine of these (numbers 5 to 12) were taken directly from the original Rumelhart (1975) version. Rules 1 to 4 reflect the modifications of Thorndyke (1975) who refined Rumelhart's first two rules to express more precisely the story components and their inter-relationships. In addition, Thorndyke (1975) introduced in his grammar the story component "resolution". This has been included in the present grammar as rule 14. Following Rumelhart's symbol system, "+" will be used to indicate story components in sequence; the slash symbol "/" will indicate alternatives that are mutually exclusive; an asterisk "*" will indicate the option of repeating the component; and finally the symbol "()" will indicate optionality of the component.

Procedures and Findings. Following Rumelhart's procedures, each story was first parsed into single propositions. Then the story grammar was used to identify the story components, and to generate the organization of the story structure. A comparison of the two narrative selections revealed quite similar general story structures composed of setting statements, four episodes, and resolution statements. Variation was observed in the number of single propositions and in the length of

1. Story → Setting + Plot + Resolution
2. Setting → Characters + Location + Time
3. $\left.\begin{array}{l}\text{Character}\\ \text{Location}\\ \text{Time}\end{array}\right\} \rightarrow$ (states)*
4. Plot → Episode*
5. Episode → {Event + Reaction}
6. Event → {Episode / change of state / action / event + event}
7. Reaction → Internal response + overt response
8. Internal response → {emotion / desire}
9. Overt response → {action* / (attempt)*}
10. Attempt → plan + application
11. Application → (Preaction)* + action + consequence
12. Preaction → subgoal + (attempt)*
13. Consequence → {reaction / event}
14. Resolution → {event* / state*}

Explanatory comments:

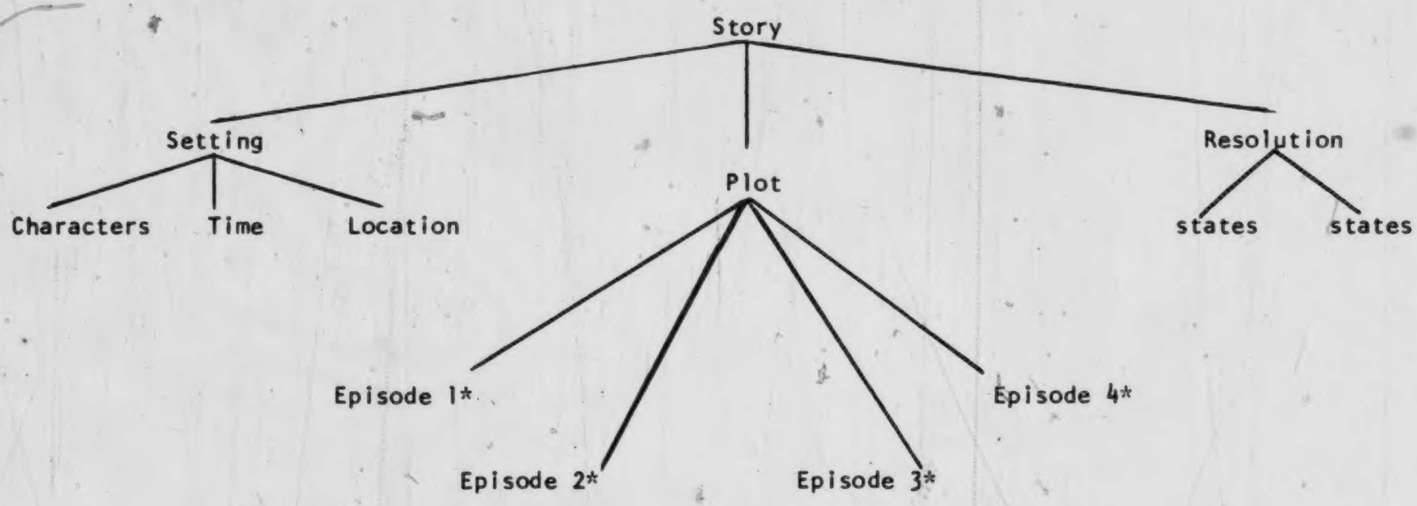
The symbol "+" is used to indicate two items in a sequence.

The symbol " / " is used to separate mutually exclusive alternatives.

The symbol " * " is used to indicate one or more of the items.

The symbol "( )" indicates that the item may or may not be present.

Figure 4.1 RULES FOR STORY GRAMMAR USED IN ANALYSIS OF NARRATIVE SELECTIONS


Story
Setting
Characters
Time
Location
Plot
Episode 1*
Episode 2*
Episode 3*
Episode 4*
Resolution
states
states

* See Appendix C, pages 278-293 for the detailed episode analyses.

FIGURE 4.2 GENERAL STORY STRUCTURE FOR NARRATIVE SELECTIONS

these units within each story. There were 60 units in "Scotty Becomes A Hero", and 52 units in "Miss Bella's Plan." The general story structure generated by the story grammar analysis is illustrated in Figure 4.2. The texts of the actual stories, the parsed propositions, the generated story structures, and the directional questions used in the DQIT are found in Appendix C, pages 278 to 293. In addition to providing the basis for comparision of selections' internal story structures, and guiding the development of the backward-looking inferences for the "Directional-Question Inference Task" (DQIT), the generated story structures were also used to evaluate the subjects' retelling of the story in the "Story-Recall Inference Task" (SRIT). This use of the story grammar will be discussed in Chapter 6 as part of the data analyses for the reading related tasks.

SUMMARY

This chapter has presented the initial analyses of selected reading materials to establish the existence of forward and backward looking inferences in reading programs currently in use, and the development of the reading-related inference tasks used in the major study. Two pilot studies have been reported. Finally, a detailed analysis of surface and internal aspects based on readability and story grammar comparisions have been presented for the two narrative selections used as stimuli for the inference tasks. The next two chapters will describe the analyses and findings related to the data gathered in the study. Chapter five will present the analyses and findings relative to the cognitive synthesis tasks. This will provide the framework for Chapter 6 which will present the analyses and findings related to the inference tasks.

CHAPTER 5

ANALYSES AND FINDINGS: COGNITIVE SYNTHESIS TESTS

In order to explore the relationship between cognitive synthesis and generating inferences in reading comprehension, the forty subjects were first classified according to their performance scores on the two kinds of cognitive synthesis identified by Luria (1966a) as successive and simultaneous. To do this, two tasks from the Das battery of cognitive synthesis tests were selected and administered to the entire sample by the investigator. A detailed account of the procedures followed has been presented in Chapter 3. The tests administered were (1) the Visual Short Term Memory Test, and (2) the Memory for Design Test. In this chapter the analyses of the data generated from these two tests, and the quantitative findings will be presented.

IDENTIFICATION OF SYNTHESIS GROUPS

The major purpose of this phase of the study was to identify the subjects accoring to their performances on both successive and simultaneous synthesis, since previous research (Luria, 1966b; Latham, 1973; Leong, 1974; Leong, 1976; Kirby and Das, in press) has shown consistently that the task of reading requires both types of synthesis. In this section, the analyses and findings for each of the synthesis tests will be presented first. This will be followed by a description of the procedures used in classifying the subjects into four cognitive synthesis groups. The results of a chi-square comparison of the cognitive synthesis groups and reading proficiency will be reported.

Initial Anaylses and Findings

The analyses and findings are presented in the following order: first, successive synthesis (Visual Short Term Memory Test), and then, simultaneous synthesis (Memory for Design Test).

Successive Synthesis. As soon as possible after the administration of the Visual Short Term Memory Test, each subject's response booklet was hand scored by the investigator. A master answer sheet was used for this scoring. (See Appendix A, p.263). Later each booklet was rescored by an independent judge who concurred with the scores assigned initially by the investigator. The total scores for the forty subjects ranged from 32 to 97. These scores were then ranked from highest to lowest, and the median score was calculated to be 78.5. With the calculation of the median, the subjects were divided into two groups and classified as either high successive (i.e. those subjects with scores above the median), or low successive (i.e. those subjects with scores below the median). Twenty subjects were classified in each category.

Simultaneous Synthesis. The subjects' reproductions for the Memory for Design Test were scored by the investigator. The scores generated by this test are error scores and therefore of negative values. To eliminate this negative quality a constant of 50 was added to each subject's total score. These transformed scores ranged from 22 to 46. The median score was calculated to be 39.5. Those subjects who ranked above the median were classified as high on simultaneous synthesis, while those subjects who ranked below the median were classified as low. There were twenty subjects in each category.

For the present study, specific criteria were developed to guide the scoring of the subjects' reproductions of the fifteen designs. (See Appendix B, p.269). This was necessary since it was found that the original guidelines (Graham and Kendall, 1960), which were developed to detect brain damaged subjects, did not distinguish adequately among the regular classroom subjects observed. The problem was recognized earlier by Leong (1974, p.207) who called for clearer deliniation of scoring criteria. Although Leong (1974) developed a set of criteria for the *Figure Copying Test*, he did not do so for the *Memory for Design Test*. Later studies (Krywaniuk, 1974; Jarman, 1975; Kirby, 1976) have indicated use of Leong's general guidelines for the *Figure Copying Test* with an emphasis on "the maintenance of relations and proportions" rather than "the presence and accuracy of details". (Kirby, 1976, p.45.)

After the subjects' reproductions of the fifteen designs were scored by the investigator, fifteen test booklets were randomly selected and submitted to independent judges for rescoring. Reliability coefficients were calculated using the formula described in Chapter 4, p. 90. The results of these comparisons have been summarized in Table 5.1.

Since all coefficients were .80 or higher, and the overall agreement was at least .85, it was felt that the scores assigned by the investigator had satisfactory reliability.

Four Cognitive Synthesis Groups

As stated in the introduction to this chapter, the major purpose of this phase of the study was to classify the 40 subjects in terms of the two types of synthesis-successive and simultaneous. This was a prerequisite for the exploration of the relationships between cognitive synthesis and the reading related inference tasks.

Table 5.1 COEFFICIENTS OF AGREEMENT FOR SCORING MEMORY FOR DESIGN TEST

Stimulus Figure	Investigator and Judge 1	Investigator and Judge 2	Judge 1 and Judge 2
1	.87	.93	.87
2	.93	.80	.87
3	1.00	.87	.87
4	.93	.80	.87
5	.93	.87	.80
6	1.00	.87	.87
7	1.00	.80	.87
8	1.00	.87	.87
9	.93	.87	.87
10	.87	.80	.80
11	.93	.80	.87
12	1.00	.93	.93
13	1.00	.87	.93
14	.93	.93	1.00
15	.93	.80	.87
Total	.93	.85	.87

To classify the subjects in terms of the two types of cognitive synthesis, the rankings of the subjects based on their performance on the two tests were used. A 2 (high successive, low successive) X 2 (high simultaneous, low simultaneous) contingency table was cast, and each subject was assigned to one of the four synthesis groups so identified. The groups were: (1) high on both types of synthesis (high successive-high simultaneous), (2) high on successive, but low on simultaneous (high successive-low simultaneous, (3) low on successive synthesis, and high on simultaneous (low successive-high simultaneous), (4) low on both synthesis tests (low successive-low simultaneous).

Once the subjects had been identified as a member of one of the four synthesis groups, a 4X2 contingency table was cast to ascertain whether there was a significant difference among the four groups in terms of the subjects' reading comprehension proficiency. The observed distribution data were submitted to a chi-square test corrected for continuity to determine the statistical significance of the observed distribution.

When the four cognitive synthesis groups were compared on the basis of achievement in reading comprehension, the observed distribution revealed that the high successive-high simultaneous group was made up of 9 very proficient subjects and 1 less proficient subject. In the high successive-low simultaneous group, there were 2 very proficient and 8 less proficient subjects. The low successive-high simultaneous group was composed of 7 very proficient and 3 less proficient subjects. There were 2 very proficient, and 8 less proficient subjects in the low successive-low simultaneous group. This distribution is summarized in Table 5.2. The observed χ^2 for this distribution was 15.6 ($p < .01$, df3). This clearly indicated a significant relationship between the cognitive synthesis groups, and the reading comprehension proficiency groups as identified in this study. This relationship required further investigation to explicate the relationship indicated.

READING COMPREHENSION PROFICIENCY, SEX OF SUBJECT, AND COGNITIVE SYNTHESIS

Earlier studies by Das and his associates have been limited to male subjects. In the present study both boys and girls at both levels of proficiency were observed. Thus, in order to consider the relationship of subject's sex with cognitive synthesis, and to explore further the significant relationship between reading comprehension proficiency and cognitive synthesis revealed by the χ^2 test, means and standard

Table 5.2 COMPREHENSION PROFICIENCY AND COGNITIVE SYNTHESIS GROUPS COMPREHENSION

	Very Proficient	Less Proficient	
High Successive-High Simultaneous	9 (22.5%)	1 (2.5%)	10 (25%)
High Successive-Low Simultaneous	2 (5%)	8 (20%)	10 (25%)
Low Successive-High Simultaneous	7 (5%)	3 (7.5%)	10 (25%)
Low Successive-Low Simultaneous	2 (5%)	8 (20%)	10 (25%)
	20 (50%)	20 (50%)	40 (100%)

χ^2_{obs} = 15.6 (p .01, df3)

deviations were derived for Very Proficient (n=10) and Less Proficient male readers (n=10), and the Very Proficient (n=10) and Less Proficient female readers (n=10) for both successive and simultaneous synthesis. The data were submitted to a 2X2 two-way analysis of variance (fixed model) where the main effects were Proficiency in reading comprehension and Sex of Subject.

Successive Synthesis

The successive synthesis test (Visual Short Term Memory) was scored out of 100. On this test, the Very Proficient male readers attained a mean score of 76.0 with a standard deviation of 17.42, while the Less Proficient male readers obtained a mean score of 69.8 and a standard deviation of 15.20. When all males were combined the mean score was 72.9 and the standard deviation 16.22. The Very Proficient female readers obtained a mean score of 80.4 with a standard deviation of 7.86, while the Less Proficient female readers attained a mean score of 77.0 and a standard deviation of 17.16. When the Very Proficient and Less Proficient female readers were combined the mean score was 78.11 with a standard deviation of 13.11. When scores were collapsed across sex, the Very Proficient readers attained a mean score of 78.2 with a standard deviation of 13.34, while the Less Proficient readers obtained a mean score of 73.4 and a standard deviation of 16.21. A summary of this information is presented in Table 5.3.

To determine whether there were significant effects due to reading comprehension proficiency, or to sex of the subject, or the interaction of these two variables, the subjects' performance scores on the successive synthesis test were submitted to a 2X2 two-way analysis of variance where the main effects were proficiency and sex as reported in Table 5.4. The results of this analysis indicated no significant main effects due to proficiency level in reading comprehension (F=1.034; df=1,36; p=.32) or sex (F=1.510; df=1,36; p=.23). There was no significant interaction (F=.088; df=1,36; p=.77). This finding would appear to indicate that successive-simultaneous processing does not vary significantly across the two sexes.

Simultaneous Synthesis

For the simultaneous synthesis test (Memory For Design) a perfect transformed score was 50. On this test the Very Proficient male readers obtained a mean of 39.6 with a standard deviation of 3.92, while the Less Proficient male readers attained a mean score of 35.5 and a standard deviation of 7.07. When all males were combined, their mean score was 37.5 with a standard deviation of 5.95. The Very Proficient female

Table 5.3 SUCCESSIVE SYNTHESIS: MEANS AND STANDARD DEVIATIONS FOR READING PROFICIENCY X SEX

		SEX OF SUBJECT					
		Boys		Girls		Combined	
		$\overline{X}$	s.d	$\overline{X}$	s.d	$\overline{X}$	s.d
Reading Comprehension Proficiency	Very Proficient	76.0	17.42	80.4	7.86	78.2	13.34
	Less Proficient	69.8	15.20	77.0	17.16	73.4	16.21
	Combined	72.9	16.22	78.7	13.11		

Table 5.4 SUCCESSIVE SYNTHESIS: ANALYSIS OF VARIANCE SUMMARY TABLE FOR READING PROFICIENCY (A) X SEX (B)

Source	S.S.	d.f.	M.S.	F-ratio	Prob.
A	230.375	1	230.375	1.034	.32
B	336.375	1	336.375	1.051	.23
AXB	19.563	1	19.563	.088	.77
SE	8020.06	36	222.780		

readers obtained a mean score of 40.7 with a standard deviation of 2.58, and the Less Proficient female readers attained a mean score of 32.60 with a standard deviation of 6.02. When the females were combined, their mean score was 36.65 and a standard deviation of 6.13. When the scores were collapsed across sex, the Very Proficient readers attained a mean score of 40.15 with a standard deviation of 3.28, while the Less Proficient readers obtained a mean score of 34.05 with a standard deviation of 6.56. A summary of this information is presented on Table 5.5.

Table 5.5 SIMULTANEOUS SYNTHESIS: MEANS AND STANDARD DEVIATIONS FOR READING PROFICIENCY X SEX

		SEX OF SUBJECT					
		Boys		Girls		Combined	
		$\bar{X}$	s.d.	$\bar{X}$	s.d.	$\bar{X}$	s.d.
Reading Comprehension Proficiency	Very Proficient	39.6	3.92	40.7	2.58	40.15	3.28
	Less Proficient	35.5	7.07	32.6	6.02	34.05	6.56
	Combined	37.5	5.95	36.65	6.13		

To determine whether there were significant effects due to reading comprehension proficiency, the sex of the subject, or the interaction thereof, the subjects' performance scores were submitted to a 2X2 two-way analysis of variance where the main effects were proficiency and sex. See Table 5.6. The results of this analysis revealed a significant main effect due to level of proficiency (F=13.734; df=1,36;p=.000). There was no significant main effect due to sex (F=.300; df=1,36;p=.59), nor was there a significant interaction (F=1.47; df=1,36; p=.23).

Table 5.6 SIMULTANEOUS SYNTHESIS: ANALYSIS OF VARIANCE SUMMARY TABLE FOR READING PROFICIENCY (A) X SEX (B)

Source	S.S.	d.f.	M.S.	F-ratio	Prob.
A	372.121	1	372.121	13.734	.000 *
B	8.117	1	8.117	.300	.59
AXB	39.992	1	39.992	1.476	.23
SE	975.406	36	27.094		

* significance $\leq$ .05

DESCRIPTION OF COGNITIVE SYNTHESIS GROUPS IN TERMS OF FOUR CRITERION VARIABLES

When the sample was drawn initially, the very proficient and less proficient readers were selected purposively in terms of non-verbal IQ, chronological age, vocabulary, and reading comprehension. In Chapter 3, the sample has been described in terms of these criterion variables. With the re-assignment of the subjects to the four cognitive synthesis groups on the basis of their performances on the Visual Short Term Memory Test (successive), and Memory For Design Test (simultaneous), these variables were re-examined to ascertain whether there were significant differences among the synthesis groups in terms of the four aforementioned criterion variables. Means and standard deviations for each of the variables were calculated for each of the four synthesis groups. A 2X2 two-way analysis of variance was computed for each criterion variable in terms of the two types of synthesis (successive and simultaneous). This section reports the findings of these analyses.

Non-verbal IQ and Cognitive Synthesis

The non-verbal IQ score for each of the subjects was obtained from the student's record card. This score was based on the subject's performance on the Canadian Cognitive Abilities Test (1974). The mean non-verbal IQ scores calculated for each of the cognitive synthesis groups are listed below with standard deviations included in parenthesis: High successive-High simultaneous--111.5 (10.50); High successive-Low simultaneous--105.8 (10.06); Low successive-High simultaneous--110.6 (7.47); Low successive-Low simultaneous--112.9 (6.17). This information has been summarized in Table 5.7.

When the non-verbal IQ data were submitted to the two-way analysis

Table 5.7 CRITERION VARIABLES FOR COGNITIVE SYNTHESIS GROUPS: MEANS AND STANDARD DEVIATIONS

Cognitive Synthesis Groups	VARIABLE							
	NVIQ $\bar{X}$	s.d.	C.A. $\bar{X}$	s.d	VOC. $\bar{X}$	s.d.	COMP. $\bar{X}$	s.d.
High Successive- High Simultaneous	111.5	(10.50)	113.5	(2.12)	89.10	(6.72)	87.0	(15.29)
High Successive- Low Simultaneous	105.8	(10.06)	114.7	(3.62)	79.40	(8.78)	55.0	(19.07)
Low Successive- High Simultaneous	110.6	(7.47)	114.5	(2.17)	92.20	(5.51)	81.5	(20.61)
Low Successive- Low Simultaneous	112.9	(6.17)	113.2	(3.01)	78.50	(8.90)	51.4	(24.69)

of variance, the test indicated there was no significant effects due to either successive (F=1.272; df=1,36; p=.27) or simultaneous (F=391; df=1,36; p=.54) synthesis, or the interaction (F=2.094; df=1,36; p=.16) thereof. A summary of this analysis is given in Table 5.8.

Table 5.8 CRITERION VARIABLES: ANALYSIS OF VARIANCE SUMMARY TABLES FOR SUCCESSIVE (A) X SIMULTANEOUS (B) SYNTHESIS

1. VARIABLE: NON-VERBAL IQ

Source	S.S.	d.f.	M.S.	F-ratio	Prob.
A	97.125	1	97.125	1.272	.27
B	29.875	1	29.875	.391	.54
AXB	15.993	1	15.993	2.094	.16
SE	2749.50	36	76.375		

2. VARIABLE: CHORNOLOGICAL AGE

Source	S.S.	d.f.	M.S.	F-ratio	Prob.
A	1.687	1	1.687	.215	.64
B	1.250	1	1.250	.159	.69
AXB	15.625	1	15.625	1.989	.17
SE	282.750	36	7.854		

3. VARIABLE: READING VOCABULARY

Source	S.S.	d.f.	M.S.	F-ratio	Prob.
A	12.00	1	12.00	.206	.65
B	1368.81	1	1368.81	23.583	.00*
AXB	39.94	1	39.94	.688	.41
SE	2089.04	36	58.04		

4. VARIABLE: READING COMPREHENSION

Source	S.S.	d.f.	M.S.	F-ratio	Prob.
A	207.063	1	207.063	.507	.48
B	9641.060	1	9641.060	23.628	.00*
AXB	9.000	1	9.000	.022	.88
SE	14688.89	36	408.26		

*significance $\leq$ .05

This analysis revealed that there was no significant difference among the four cognitive synthesis groups in terms of non-verbal IQ. The earlier study by Kirby and Das (in press) indicated a significant difference due to both successive and simultaneous synthesis for non-verbal IQ. The fact that the findings of the present study do not support earlier findings is probably reflective of the manner in which the subjects of the present sample were selected (i.e. Very Proficient and Less Proficient readers were matched for non-verbal IQ in an attempt to equate the two groups on academic potential).

Chronological Age and Cognitive Synthesis

The chronological age for each subject was computed in months as of January 31, 1977. The mean chronological age for the High successive-High simultaneous group was 113.5 months with a standard deviation of 2.12. For the High successive-Low simultaneous the mean age was 114.7 months with a standard deviation of 3.62. A mean age of 114.5 months and a standard deviation of 2.17 was calculated for the Low successive-High simultaneous group, and a mean age of 113.2 months with a standard deviation of 3.01 was computed for the Low successive-Low simultaneous group. This data is summarized in Table 5.7. The two-way analysis of variance by successive and simultaneous synthesis revealed no significant main effects for either successive (F=.215; df=1,36; p=.64), or simultaneous (F=.159; df=1,36; p=.69) synthesis. Nor was the interaction significant (F=1.989; df=1,36; p=.17). These anaylses revealed that there were no significant differences among the four cognitive synthesis groups in terms of their chronological ages. This finding confirmed the investigator's attempt to control for the variable of chronological age.

Reading Vocabulary and Cognitive Synthesis

The vocabulary scores for each subject were based on the percentile standings for the Stanford Reading Achievement Test (1964). These scores were obtained from the students' record cards. The mean percentile vocabulary scores with the standard deviations in parenthesis are given below for each of the cognitive synthesis groups: High Successive-High Simultaneous--89.10 (6.72); High Successive-Low Simultaneous--79.40 (8.78); Low Successive-High Simultaneous--92.20 (55.1); Low Successive-Low Simultaneous--78.50 (8.90) as reported in Table 5.7.

When these data were submitted to a two-way analysis of variance, no significant difference was revealed for successive synthesis (F=.206; df=1,36; p=.65). This was also true of the interaction effect (F=.688; df-1,36; p=.41). However, there was a significant effect due to simultaneous synthesis (F=23.583; df=1,36; p=.00002). A summary of these analyses is given on Table 5.8.

These findings indicated there was no significant difference in terms of vocabulary proficiency between the high and low successive groups. But there was a significant difference between the high and low simultaneous groups on vocabulary proficiency. Inspection of the means revealed the difference was in favor of the high simultaneous group who obtained a mean vocabulary score of 90.65, while the low simultaneous group attained a mean score of 78.95. The previous study by Kirby and Das (in press) found significant differences due to both simultaneous and successive synthesis in terms of vocabulary proficiency.

The differences between the findings of the Kirby and Das study and the present study are attributable, in part, to the differences in the samples studied. Kirby and Das sampled all levels of vocabulary proficiency with fourth grade males. The present study sampled only subjects who were proficient in vocabulary development (above the 70th percentile, i.e. above grade level). This greatly limited the range of proficiency studied. In addition the findings of the present study have been influenced by the strong interrelation between reading proficiency and simultaneous synthesis. The composition of the cognitive synthesis groups reflected this interrelationship. Nine out of ten subjects in the high successive-high simultaneous group were very proficient readers, and seven out of ten in the low successive-high simultaneous group were very proficient. On the other hand, eight out of ten of the high successive-low simultaneous group were less proficient in reading. The same number of less proficient readers were found in the low successive-low simultaneous group. It would appear from the findings of the present study that simultaneous synthesis discriminates the proficiency level of vocabulary development more effectively than does the successive synthesis. The theoretical implications of this finding will be explored in Chapter 7.

Reading Comprehension and Cognitive Synthesis

The comprehension scores for the subjects were based on the percentile standing for the Stanford Reading Achievement Test, (1964) and were obtained from the students' record cards. The mean percentile comprehension scores with standard deviations in parenthesis are listed below for each of the cognitive synthesis groups: High successive-High simultaneous--87.0 (15.29); High successive-Low simultaneous--55.0 (19.07); Low successive-High simultaneous--81.5 (20.61); Low successive-Low simultaneous--51.4 (24.69). This information has been reported in Table 5.7.

A two-way analysis of variance revealed no significant main effects due to successive synthesis (F=.507; df=1,36; p=.48), and no significant interaction (F=.022; df-1,36; p=.88). Again a significant effect was indicated due to simultaneous synthesis (F=23.628; df=1,36; p=.00001). This analysis is summarized in Table 5.8.

When the means for the simultaneous groups were inspected, it was found that the difference was in favour of the high simultaneous group whose mean reading comprehension score was 84.25, while the low simultaneous group obtained a mean score of 53.20. Again there is a discrepancy between the findings of Kirby and Das and the present study. The earlier research revealed significant main effects for both simultaneous and successive synthesis. In this study significance was indicated only for simultaneous synthesis. The influence of the nature of the samples, and the distribution of the Very Proficient and Less Proficient in the cognitive synthesis groups was observed. Clearly the simultaneous task had distinguished between the Very Proficient (16 out of 20 ranked high), and the Less Proficient (only 4 out of 20 ranked high). The successive synthesis task did not discriminate as definitively as the Very Proficient (11 out of 20 ranked high) from the Less Proficient (9 out of 20 ranked high). Kirby and Das reported that neither of the two types of synthesis clearly discriminated the High Successive-Low Simultaneous from the Low Successive-High Simultaneous groups of subjects. In this study, it is definitely the aspect of simultaneous synthesis that distinguished the two groups.

In this section findings have been presented which demonstrated no significant difference among the cognitive synthesis groups in terms of academic potential as measured by non-verbal IQ, or chronological.age. Significant main effects due to simultaneous synthesis were found for both vocabulary and reading comprehension proficiency. There was no significant main effect due to successive synthesis on

Table 5.9 SUMMARY OF FINDINGS FROM ANALYSES OF SUBJECTS' PERFOMANCE SCORES ON COGNITIVE SYNTHESIS TESTS

Basis of Comparison	1. Distribution of Reading Proficiency Levels in Cognitive Synthesis Groups	2. Relationship of Reading Proficiency and Sex to Successive and Simultaneous Synthesis	3. Relationship of Successive and Simultaneous Synthesis to Selected Criterion Variables of Non-verbal IQ, Chronological Age, Reading Vocabulary, and Reading Comprehension
Statistical Test	χ^2	2-Way ANOVA	2-Way ANOVA
Finding(s)	There was a significant difference in the distribution of the Very Proficient and Less Proficient Readers in the four cognitive synthesis groups.	There were no significant interaction effects. There were no significant main effects due to Sex. There was no significant main effect due to Reading Proficiency for Successive Synthesis. There was a significant main effect due to Reading Proficiency for Simultaneous Synthesis.	There were no significant interaction effects. There was no significant main effect due to Successive Synthesis for NV-IQ, CA, Reading Vocabulary, or Reading Comprehension. There was no significant main effect due to Simultaneous Synthesis for NV-IQ, or CA. There was a significant main effect due to Simultaneous Synthesis for both Reading Vocabulary, and Reading Comprehension

these two variables. There were no significant interactions between the two types of synthesis for any of the four criterion variables.

SUMMARY

This chapter has presented the analyses and findings for the successive synthesis (Visual Short Term Memory), and simultaneous synthesis (Memory for Design) tests. The statistical analyses included a chi-square test and two way analysis of variance. The findings of these analyses have been summarized in Table 5.9. These findings have been discussed briefly in the light of previous research. Further discussion may be found in Chapter 7.

The four cognitive synthesis groups identified and described in this chapter provide the framework for linking the subjects' performances on the cognitive synthesis tests and reading-related inference tasks which are reported in the next chapter.

CHAPTER 6

ANALYSES AND FINDINGS: READING RELATED INFERENCE TASKS

Three reading related inference tasks were completed by each of forty subjects in individual introspective-retrospective interview sessions. These were: (1) Oral-Reading Inference Task (ORIT); (2) Story-Recall Inference Task (SRIT); (3) Directional-Question Inference Task (DQIT). These tasks have been described in detail in Chapter 4.

Each oral introspective-retrospective interview was first audio taped, and later transcribed into written protocols. The analyses of these protocols, both qualitative and quantitative, are described in this chapter. Where the data were amenable to statistical treatments, appropriate techniques were used. Findings related to these analyses will be reported. Each of the three tasks will be described independently in the order they have been listed above. This will be followed by a summary discussion.

ORAL-READING INFERENCE TASK

The Oral-Reading Inference Task required the subject to introspect as he read orally one of the two stimulus stories. The oral reading and verbalized introspection were tape recorded. Written protocols were transcribed for each subject's performance on the task. These were submitted to a qualitative content analysis. The final form of this analysis was determined after the written protocols had been transcribed. In this way not only the theoretical structures drawn from the survey of related literature, but also the responses of the subjects, determined the classification system which was developed by the investigator. The development of this classification system will be described in the next section.

Derivation of Categories for Qualitative Analyses

Although broad potential categories were generated by the review of the related literature, the actual classification system reflected considerable modification and refinement based on the actual responses of the subjects. For example, while the general categories of forward and backward-looking inferences grew out of Schank's writings; the categories of "supported" and "non-supported" were generated to encompass the actual responses. Likewise, the category of "translations" and "filler postcripts" reflects the actual responses of the subjects. On the other hand, it was anticipated that the four detailed levels of information proposed by Baker, Prideaux and Derwing would be useful in classifying the kind of information subjects were using to generate their inferences. However, the data produced by ORIT and SRIT did not indicate with sufficient clarity the use of sentential information (I_s) or relational meaning (I_r). Thus, the more general classification of "word level", "sentence level", and "beyond sentence level" were created to account for the data produced.

The Classification System: Definitions and Illustrative Examples

The classification system finally used in the analysis of ORIT consisted of six levels of dichotomous categories. (See Figure 6.1) The choice of the dichotomous format was based on the comprehensive review of content analysis research by Holsti (1968). He stressed that the dichotomous form of analysis generated a higher degree of reliability than multiple decision categories.

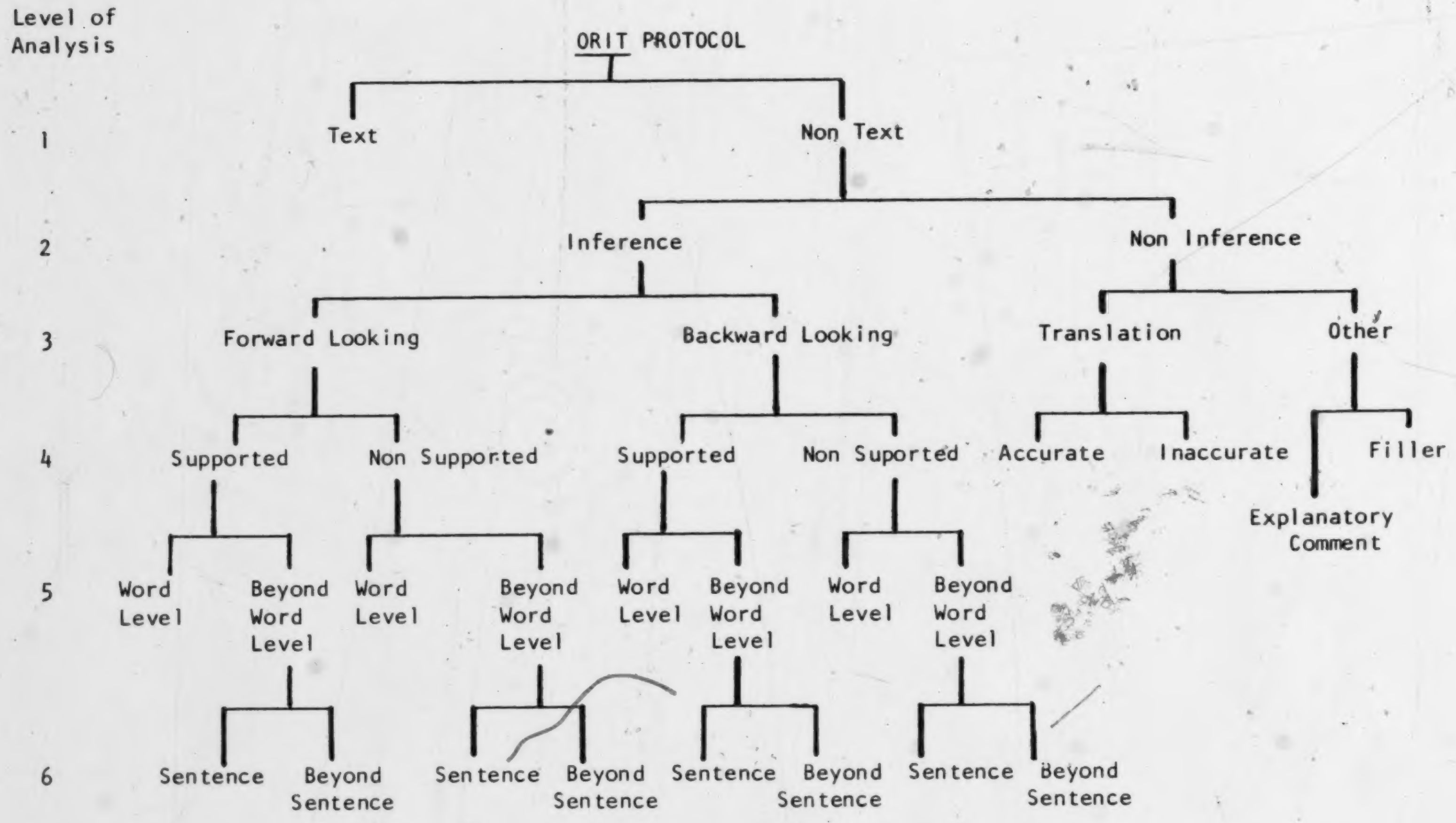

Level of Analysis
1
2
3
4
5
6
ORIT PROTOCOL
Text
Non Text
Inference
Non Inference
Forward Looking
Backward Looking
Translation
Other
Supported
Non Supported
Supported
Non Suported
Accurate
Inaccurate
Filler
Explanatory Comment
Word Level
Beyond Word Level
Word Level
Beyond Word Level
Word Level
Beyond Word Level
Word Level
Beyond Word Level
Sentence
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Figure 6.1 DICHOTOMOUS CATEGORIES USED IN QUALITATIVE ANALYSES OF ORIT

Level 1: Text-non-text. At the first level of analysis the ORIT protocols were divided into the subject's oral reading of the "Text" or his "Non-text" introspective comments. In the examples below, the "Non-text" comments have been set off by braces to separate them from the subject's oral reading of the "Text".

Subject #35: ...Whenever sickness struck one of the homes of the neighbours Miss Bella was there to help. {Well she must be nice then} Days came when the leaves on the trees changed colour {That must be fall} Then the sounds ...

Subject #3: ...Sitting up quickly, Father called, "I smell smoke! Get up everyone!" {Cause he wanted to get everyone out cause there's a fire} Mother scrambled out of bed...

The examples illustrate the difference between the two types of response with sufficient clarity, so no further discussion will be given. Since the focus of the present study was on the "Non-text" rather than the "Text" responses, the latter were not analyzed further.

Level 2: Inference-Non-Inference. The second decision level required the identification of each "Non-text" response as either an "Inference" or a "Non-inference". To be identified as an "Inference", the subject's response had to generate new information related to the text. All other responses were classified as "Non-inference". In the following examples, the "Inferences" have been placed in square brackets, and the "Non-inference" in round brackets.

Subject #38: ...Whenever sickness struck one of the homes of the neighbours, Miss Bella was there to help.{(It says she would go to the house and help) [Maybe bring some medicine over from the store while somebody was watching the sick person]}. The days came...

In this example, the subject's first comment merely restates the information given in the text; therefore, it was classified as "Non-inference". However, the second statement goes beyond the information provided in the text. It thus was classified as an "Inference". At this point in the analysis the kind of inference, and whether it was textually supported was not considered.

Subject #25: ...They were met by the cold night air as they stumbled on to the lawn. {(It must have been a cold night)} Bells clanged and men were shouting as three fire engines stopped in front of their house {[Well maybe they were called out.] [Maybe someone found out about it sooner than they did.]} In a minute they had...

Again the first response restates information provided in the text. The second two statements go beyond the text and add new information. The former was classified as a "Non-inference", and the latter two as "Inferences".

Level 3. At the third level, two dichotomous decisions had to be made. (a) The first required the classification of each identified inference as either "Forward-looking" or "Backward-looking". The definitions provided in Chapter 1 were used to guide this decision. (b) The second decision involved the "Non-Inferences" responses which now were further categorized into "Translations", or "Other" statements.

3a "Forward-Looking - Backward-Looking". The "forward-looking" inferences went beyond the text to generate new information which elaborated the given textual information. The "backward-looking" inferences gave necessary information that linked a given unit of textual information with previous information, or supplied a cause for a given action in the text. Some backward inferences supplied explanatory feelings to link and/or explain textual events. In the examples, the "forward-looking" inferences" have been underscored with a broken line, and the "backward-looking inferences" have been underscored with a solid line.

Subject #6: ...The young clerk wiped the forehead with the back of his hand. {[Well, he must have been sweaty cause he's a young clerk]}...

In this example, the subject has generated a "backward-looking inference" that provides a cause for the clerk's stated action.

Subject #1: ...She shuddered with each report. {[Like she's sad because everybody's shooting at her animals.]}

This backward inference generates Miss Bella's feelings resulting from the shots which echoed through her woods. It links her shuddering with the previous information, and supplies an emotive cause for the stated action.

Subject #35: ...Days came when the leaves on the trees changed colour {[That must be fall]} Then the sounds of shots echoed through the woods from Miss Bella's farm. {[Probably duck hunters, or something, or animal hunters]}

In both these instances of introspective responses, the subject has gone beyond the information given and elaborated it with additional information. So these were identified as "forward-looking inferences".

Subject #36: ...Although he couldn't talk, he let everyone know what he wanted. {[So he just barked and scratched on the floor if he wanted outside.]}

Subject #32: ...He even showed his dislike for the neighbour's cat by barking furiously at it whenever it happened to appear. {[He's kinda cruel.]}

In the first example, the "forward-looking inference" provides elaborative information. In the second example, the subject has used the textual information to make a judgemental "forward-looking inference" about the dog's character.

3b "Translation - Other". The second dichotomous decision made at this level dealt with the "Non-Inference" responses. These were now identified as either "Translation" statements in which the subject generally restated textual information in his own words, or "Other" non-inference responses. In these examples, the "Translation" statements have been underlined with two lines, and the "Other" responses have been underlined with a wavy line.

Subject #15: ...If he wanted outside he went to the door and barked sharply. {(Well he goes to the door and he barks.)} When he was hungry he would go to his dish and bark until someone came to feed him. {(Well he'd just go to his dish and bark.)} He even showed...

In each of the above responses the subject has merely restated or translated the given information in his own words.

Subject #34: ...Miss Bella lived by herself in a little white cottage. {(She lived by herself in a white cottage.)} It was on a small farm by the highway between Riverside and Treesdale. {(It was by the highway between Riverside and - between two towns.)}

Again the subject merely restates some of the given textual information. The following are examples of "Other" non-inference responses.

Subject #24: ...She was very fond of the wild animals and birds that lived in the woods, and the fields of her farm. {(And she really loved the animals) (and everything)}.

In this example the translation statement has a non communicative add-on, which was one type of "Other" non-inference response. Another type of "Other" non-inference response is illustrated below.

Subject #33: ...Father tried to settle back to sleep but Scotty kept on barking. Then he bounded up the stairs making a terrible racket all the way. {(I don't know why he was doing that.)}

Level 4. At this level of the analysis four dichotomous decisions were made. Two of these determined whether the "forward-looking inferences" and the "backward-looking inferences" were "supported" by the text or "non supported". The third decision identified the "Translation" responses as "Accurate" or "Inaccurate", and the fourth decision classified the "Other" non-inference responses as either "Explanatory" comments or "Filler" comments. Each of these categories will now be illustrated.

4a Supported - Non-Supported Forward-Looking Inferences. Each of the identified "forward-looking inferences" was now checked to determine whether it was textually supported or not. The following are examples of inferences for which there was support in the textual information. A "c" above the inference indicates "support".

Subject #12: ...The men were shouting orders as the three fire engines roared to a stop in front of their house. {[So that means the fire must be very very big.]}

Subject #1: ...and on the ground small animals prepared for winter. {[They got food and they store it for winter.]}

Subject #24: ...The days came when the leaves on the trees changed colours. {[That means like it has to be autumn or near there when the leaves change to different colours.]}

Unsupported "forward-looking inferences" were those in which the subject went beyond the textual information, or violated the textual information so that the information generated was not supported. The following examples are illustrations of "non-supported forward-looking inferences". Again the inferences have been underlined to separate them from the Oral reading of the "Text". An "X" has been placed above each inference to indicate "non-support".

Subject #25: Scotty was the Brown's pet terrier. {[It must belong to a boy or girl.]} Although he couldn't talk...

Subject #18: ...She was very fond of the wild animals and birds that lived there in the woods, {[so it must have been a park] (or something) [that wild animals could live in]} , and the fields of her farm. Although the fondess...

Subject #34: ...Whenever sickness struck one of the homes of the neighbours Miss Bella was there to help. {[So she must be a kind of nurse] (or something)]}.

Subject #7: ...Sitting up quietly Father called, "I smell smoke. Get up everyone." {[The house is burning cause the toaster started on fire.]}

4b Supported - Non-Supported Backward-Looking Inferences. As described in the section above the "backward-looking inferences" were checked also for textual support. The "non-supported" backward-looking inferences often reflected inappropriate linkage. Examples of both "supported" and "Non-supported" backward-looking inferences follow. The supported inferences are illustrated first.

Subject #38: ...She quickly put on her coat, and went to warn away the unwelcome visitors. {[She went cause she didn't want the guys to kill the animals.]} They certainly had paid no attention...

Subject #25: ...Sitting up quickly Father called, "I smell smoke. Get up everyone. {[There must be a fire somewhere.]} Father scrambled...

Subject #18: ...The young clerk wiped his forehead with the back of his hand. {[He must have been sort of nervous.]} The news that...

Subject #3: ...When he was hungry, he would go to the dish and bark until someone came to feed him. {[Cause he wanted his food.]} He even showed his dislike...

Examples of non-supported inferences follow.

Subject #4: ...The next day Miss Bella went to Riverside to shop. Her first stop was the hardware store. {[She needs to get things to cure her people.]} I've decided to...

Subject #21: ..."I've decided to take up hunting she smilingly told the young clerk {[Means she doesn't like the animals anymore, and she wants to kill them.]} She asked to see...

Subject #26: ...Father tried to settle back to sleep, but Scotty kept on barking. {[The dog keep on...well the cat musta stayed, and Scotty...well the dog didn't want it there, and the dog kept on barking.]} Then he bounded...

4c Accurate - Inaccurate Translations. At this level of the analysis the "Translation" responses identified in level three were further categorized into "accurate translations" which accounted for the textual information and "inaccurate translations" which indicated a misinterpretation of the textual information. The first three examples illustrate "accurate" translation responses. The "translations" have been underscored with double lines.

Subject #4: ...She was very fond of the wild animals and birds that lived in the woods and fields of her farm {(Well she likes animals and she likes nature)} Although her fondness...

Subject #32: ...And when he was hungry he would go to his dish and bark until someone came to feed him. {(He didn't wait until they gave him food, he just barked like until they came.)} He even showed...

Subject #24: ...All I need now is a gun and some shells, {(some bullets)} Then I'll be ready to have some fun...

Inaccurate translations which illustrate the misinterpretation of textual information are given below.

Subject #2: ..."Scotty will lead us out if we follow him." {(They're trying to tell Scotty to follow,)} (or something) As the children...

Subject #38: ...She quickly put on her coat and went out to warn away the unwelcome visitors {(So she's going to warn the animals about the hunters.)} They certainly...

Subject #6: ...Although her fondness of the wild animals was not well known, her kindness toward the people was. {(Like they knew her more than the wild animals did, maybe.)} Whenever sickness...

4d Explanatory Comments and Filler Comments. At the fourth level of analysis the "Other" non-inference response were categorized into explanatory comments in which the subject made a comment that explained how he felt about the story, that he had no thoughts about what he had just read, loss of place when reading orally, or a lack of understanding.

Subject #17: ...The floor and the walls were all ablaze. The heat was deadly. {(It's sort of exciting.)} Finally they reached

Subject #2: ...Jerry and Cindy followed Scotty down the steps. {(Umm.. the kids..no I can't think of anything for that one.)} Their eyes burned...

Subject #15: ...He even showed his dislike for the neighbour's cat by barking furously at whatever it happened to appear {(Nothing.)} But his barking tonight...

Subject #9: ...Although her fondest of wild animals was not well known her kindness toward the other people was. {(I don't quite get that, they end at was...just end at was.)} Whenever sickness...

The other category of "Filler" represented the students' vocalizations such as "Umm", "ah", "er", which filled in the silence while they thought out their responses. It also included a number of "postscript" or tack-on phrases which were structurally complete but semantically empty. These were found at the end of a number of subjects' responses. In the examples below the "postcript fillers" have been bracketed.

Subject #2: ...Scotty will lead us out if we follow him. {(They're trying to tell Scotty to follow) (or something like that)} As the children...

Subject #13: ...Although he couldn't talk, he let everyone know what he wanted. {[He'd bark] (and stuff)} If he wanted...

Subject #8: ...At last the flames were out and only smoke and steam could be seen coming from the broken windows. {[So (the windows were broken and there's alot of smoke and steam) (and all that).} Alot of damage...

Subject #5: ...It was on a small farm by the highway between Riverside and Treesdale. {(It must have been between two towns) (or something)} She lived there ever since..

Subject #18: ...On the ground small animals prepared for winter. It means they were getting ready to hibernate {(and that).}

Subject #24: ...The next day Miss Bella went to Riverside to [illegible]. {[So she's gone to a store; she has to get something,] (or something like that)} Her first stop was...

Levels 5 & 6: Unit of Support. The last two levels of the analysis attempted to identify the size of information unit on which the subject based his inference. Some inferences were clearly linked to specific words. Others seemed more related to a sentence. A third group of inferences indicated information across sentences being used. For this last group the "beyond sentence" identification was made. Illustrative examples are provided below.

5a Word Level. These examples of inferences appear based on a specific word. The stimulus word has been bracketed and the related inference underlined.

Subject #26: ...Sitting up quickly Father called, "I smell (smoke). Get up everyone." {[There musta been a fire in the house.]} ...

Subject #25: ...Although he couldn't talk, he let everyone know what he (wanted) {[He must want something really badly.]} ...

Subject #5: ...There she would fire two or three blasts into the mud bank of the little (creek). {[There must have been a creek running through there-her farm]}

5b Sentence Level. Other inferences reflected the information from an entire sentence as the base. Such inferences and their related sentences have been illustrated in the following examples.

Subject #11: ...The news that Miss Bella had taken up hunting quickly spread to all the local folk. {[That means that someone found out and told another person and so on]} ...

Subject#34: ...The days cme when the leaves on the trees changed colour. {[It must be fall]} ...

Subject #6: ...You'll have to stay close to the floor so the smoke will not choke you {[So he wants them to crawl along the floor.]} ...

5c Beyond Sentence Level. Many of the inferences generated reflected information drawn from a number of sentences. These are illustrated in the examples that follow.

Subject #18: ...If she ever saw a visiting hunter she would squint through her glasses at him. Then she would wave her gun in his direction as though she had mistaken him for game. Whenever this happened the hunter was quick to leave. {[That means he's sort of scared]} ...

Subject #20: ...Father tried to settle back to sleep, but Scotty kept on barking. Then he bounded up the stairs raising a terrible racket all the way. (Then he ran upstairs barking.) Sitting up quickly, Father called, "I smell smoke. Get up everyone {[That must have been why Scotty was barking, because there was a fire]}...

Subject #36: ...If he wanted outside he went to the door and barked sharply. When he was hungry he would go to his dish and bark until someone came to feed him {[So he was kinda like a spoiled dog.]}...

Reliability of the Classification System

Six of the forty ORIT protocols were randomly selected and checked by two independent judges in order to estimate the reliability of the classification system. The reliability coefficients were computed in the manner described in Chapter 4. A summary of these coefficients has been reported in Table 6.1.

These analyses revealed that the overall reliability coefficient did not drop below .95. Within each level of analysis, the subcategories also were quite high. The lowest reliability coefficient was .82. This was computed for the "word level" of inference support. The level of reliability indicated by these checks was considered quite acceptable considering the complexity of the system.

Findings: Qualitative and Quantitative Analyses

The category system described in the previous section guided the investigator's analyses of each subject's ORIT protocol. After all protocols had been analyzed and checked, frequency counts were made of the observed responses in each category for each subject in the four cognitive synthesis groups described in Chapter 5. From these counts summary sheets were compiled. (See Appendix F, p.313). Inspection of these summaries revealed that very limited quantities of data had been generated in several categories. This was found to be particularly true in levels five and six. Even at levels three and four

Table 6.1 INDEPENDENT COEFFICIENTS OF AGREEMENT: ORIT CLASSIFICATION SYSTEM (SIX PROTOCOLS)

Levels of Analysis		I & J_1	I & J_2	J_1 & J_2
1.	Text	1.0	1.0	1.0
	Non-Text	1.0	1.0	1.0
2.	Inference	.97	.97	.95
	Non-Inference	.96	.94	.94
3.	Forward Inference	.84	.90	.84
	Backward Inference	.97	.91	.89
	Translation	.95	.94	.94
	Other	1.0	1.0	1.0
4.	Supported FLI	.90	.83	.86
	Non-Supported FLI	.93	.93	.93
	Supported BLI	.97	.91	.91
	Non-Supported BLI	1.0	1.0	1.0
	Accurate Translation	.97	.94	.94
	Inaccurate Translation	1.0	.97	.97
5	Word Level Support	.82	.82	.82
&	Sentence Level Support	.89	.87	.87
6	Beyond Sentence Level Support	1.0	1.0	1.0
All Levels Combined		.97	.95	.96

I = Investigator

J_1 = Judge 1

J_2 = Judge 2

FLI = Forward Looking Inference

BLI = Backward Looking Inference

very limited data was generated by some of the subjects. This was due in part to the unstructured nature of the task. Each subject determined when and to what extent he reported his thoughts while reading the stimulus selection orally.

The above described situation resulted in considerable variation in the quantity of introspective responses made within each of the cognitive synthesis groups. For example, in the Low Successive - Low Simultaneous group, one subject gave no introspective responses at all. He simply read the selection. When asked if he had thought anything about the story while he was reading it, he replied, "I just felt sad when I heard about the hunters coming and killing all those animals". Although he had cognitively interacted with the story, he had not reported his thoughts. For the remaining nine subjects in this group the number of introspective responses varied from 6 to 33. The number of responses in the Low Successive - High Simultaneous group varied from 1 to 23, while the High Successive - Low Simultaneous group varied from 1 to 39. For High Successive - High Simultaneous group, the range of responses was from 12 to 42.

In an 'a posteriori' attempt to control for this variability, each subject's responses in the categories identified at levels two, three, and four of the analyses were transformed into percentages. For example, Subject #39 produced the following responses: 7 supported forward-looking inferences; 5 unsupported forward-looking inferences; 7 supported backward-looking inferences; 2 unsupported backward-looking inferences; and 22 translations. The "other" non-inference responses were few in number, and not considered since they were beyond the focus of the study. Thus a total of 43 responses were observed for this subject. When inferential responses were compared with translation responses, it was revealed that 21/43 or 49% belonged in the former category, and 22/43 or 51% were of the latter. A similar procedure was used to compare forward-looking with backward-looking inferences. The total number of inferential responses was 21; of this 12/21 or 57% were forward-looking, and 9/21 or 43% were backward-looking. Likewise, for the "supported" and "non-supported" categories for each of the inference types, the procedure was repeated. In this instance, these were 12 forward-looking inferences produced; 7/12 or 58% of these were classified as supported by textual information, and 5/12 or 42% were categorized as not textually supported. For the backward-looking inferences a total of 9 were generated, and 7/9 or 78% were considered textually supported, while 2/9 or 22% were identified as not supported.

Cognitive Synthesis Groups. The transformed percentage scores were used to compute means and standard deviations for each of the four cognitive synthesis groups for the categories of forward-looking inferences, backward-looking inferences, and supported inferential responses. A summary of the means and standard deviations has been reported in Table 6.2. To explore the relationship between successive and simultaneous synthesis and the percentage of forward and backward-looking inferences, a 2X2 analysis of variance was computed for each type of inference. A summary of these analyses has been given in Table 6.3. The analyses revealed no significant main effect due to either successive (F(1,36)=.052;p=.82 or simultaneous synthesis (F(1,36)=.22;p=.64, or the interaction thereof (F(1,36)=.006;p=.934) for the forward-looking inferences. Likewise, for the backward-looking inference, no significant main effects due to successive

Table 6.2 PERFORMANCE ON ORIT BY COGNITIVE SYNTHESIS GROUPS: MEANS AND STANDARD DEVIATIONS

	FLI[2]		BLI[3]		SIR[4]	
Group*	X̄	(s.d)	X̄	(s.d.)	X̄	(s.d.)
HH	54.6	(20.06)	43.8	(20.06)	83.1	(17.54)
HL	57.8	(27.16)	40.7	(27.16)	68.4	(31.19)
LH	52.0	(25.30)	46.7	(25.30)	82.8	(12.49)
LL	56.6	(31.77)	37.8	(27.41)	60.0	(32.58)

1 HH=High Successive-High Simultaneous; HL=High Successive-Low Simultaneous; LH=Low Successive-High Simultaneous; LL=Low Successive-Low Simultaneous
2 FLI-Forward-Looking Inferences
3 BLI=Backward-Looking Inferences
4 SIR=Supported Inferential Responses

(F(1,36)=.152;p=.69), or simultaneous (F(1,36)=1.251;p=.27) synthesis, or the interaction (F(1,36)=.513;p=..47). However, in the case of support for the inferences generated, a significant main effect due to simultaneous synthesis (F(1,36)=3.97;p=.05) was revealed. Inspection of the means indicated that subjects who ranked high on simultaneous synthesis (82.9) were significantly higher than the low simultaneous (67.2) subjects.

Because of the dependent relationship between the forward-looking-backward-looking categories, and the sub-categories within these of support-non-support, the correlated t-test could not be used to examine within group differences. Therefore the decision was made to use a non-parmetric technique to see whether the observed differences were significant.

The statistical procedure selected was the Signs Test (Siegel, 1956). The tests revealed that for each of the cognitive synthesis groups

Table 6.3 ANALYSIS OF VARIANCE SUMMARY: SUCCESSIVE (A) X SIMULTANEOUS (B) SYNTHESIS FOR INFERENCE TYPES AND SUPPORT

1. Variable: Forward-Looking Inference

Source	S.S.	df	M.S.	F-Ratio	Prob.
A	36.12	1	36.12	.052	.82
B	152.12	1	152.12	.218	.64
AB	4.81	1	4.81	.007	.93
SE	25,112.5	36	697.57		

2. Variable: Backward-Looking Inference

Source	S.S.	df	M.S.	F-Ratio	Prob.
A	96.12	1	96.12	.152	.69
B	792.12	1	792.12	1.251	.27
AB	324.87	1	324.87	.513	.48
SE	22,792.24	36	633.12		

3. Variable: Supported Inferences

Source	S.S.	df	M.S.	F-Ratio	Prob.
A	18.12	1	18.12	.029	.86
B	2,480.56	1	2,480.56	3.970	.05*
AB	11.0	1	11.0	.017	.89
SE	22,491.0	36	624.75		

*significance $\leq$ .05

there was no significant difference between the number of inferential and translative responses generated (HH[10,4]:p=.754,HL[10,3]:p=.344. LH[10,2]:p=.110; LL[9,4]:p=.754). For the comparision of the quantity of inferences generated within the backward/forward-looking categories, the Tests indicated no significant differences for the four cognitive synthesis groups (HH[8,3]:p=.726; HL[10,4]:p=.754; LH[10,4]:p=.754; LL[8,1]:p=.07). However, for the comparision of the supported and non-supported forward-looking inferences, significant differences were revealed for the high successive-high simultaneous (9,0;p=.004) and the low successive-high simultaneous (9,0;p=.004) groups. The other two groups did not indicate significant differences (HL[9,2]:p=.180; LL[7,2]:p=.454). Inspections of the signs in this comparision revealed that the high successive-high simultaneous, and low-successive-high simultaneous groups produced more supported forward-looking inferences than non-supported. However, for the comparision of supported and non-supported backward-looking inferences, a significant difference beyond the .05 level was revealed for each of the cognitive synthesis groups (HH[9,0]:p=.004; HL[7,0]:p=.016; LH[8,0]:p=.008; LL[8,1]:p=.040). Once again, an inspection of the signs indicated the difference was in terms of more supported than non-supported responses. See Table 6.4 for a summary of these findings.

The significant finding for supported backward inferences indicates that all four cognitive synthesis groups efficiently related these inferences to the textual information. However, in the case of forward-looking inferences, only the high-successive-high simultaneous, and low-successive-high simultaneous groups significantly related their inferences to the textually based information. These findings seem to

Table 6.4 SIGN TESTS SUMMARY TABLE: KIND OF INFERENCE AND SUPPORT ON ORIT.

Basis of Comparison	Probability			
	Group[1] HH	HL	LH	LL
TRANS/INF	.754	.344	.110	.377
FLI/BLI[2]	.726	.754	.754	.07
FLI(S/NS)[3]	.004	.180	.004	.454
BLI(S/NS)[3]	.004	.016	.008	.040

[1] HH=High Successive-High Simultaneous; HL=High Successive-Low Simultaneous; LH=Low Successive-High Simultaneous; LL=Low Successive-Low Simultaneous

[2] FLI=Forward-Looking Inference; BLI=Backward-Looking Inference

[3] S-Supported; NS=Non-Supported

indicate that the nature of the two kinds of inferences influences a subject's ability to relate his inferential response to the textual information. The successful relating of inferential responses to textual information also appears to be related to the two types of cognitive synthesis. Those groups ranked high on simultaneous synthesis produced significantly more textually related responses for both types of inference. The groups with subjects who ranked low on simultaneous synthesis achieved significantly more textually supported responses for only the backward-looking inferences. To this point the findings presented have been based on the data generated by the first four levels of the qualitative analyses of the subjects' ORIT protocols. Consideration will now be given to levels 5 and 6 of the analysis scheme.

Levels 5 and 6 of the qualitative analysis of the ORIT protocols attempted to examine the amount of textual information used by the subjects when generating inferential responses. Three global categories were derived from the subjects' responses. These were identified as (1) word, (2) sentence, and (3) beyond sentence. Because of the unstructured nature of the task, the data generated by individual subjects did not permit statistical analysis. Rather, group percentages were calculated in an attempt to explore descriptively the levels of information the subjects were using to generate their inferences. These percentages according to the four cognitive synthesis groups have been summarized in Table 6.5.

For the forward-looking inferences, all four cognitivie synthesis groups appeared to generate the most inferences at the sentence level, and the least at the word level. For the backward-looking inferences, the same pattern was observed for the Low Successive-Low Simultaneous, and Low Successive-High Simultaneous groups. However, the High Successive-Low Simultaneous, and High Successive-High Simultaneous groups appeared to use more beyond sentence level information in the generation of backward-looking inferences. For both forward-looking and backward-looking inferences all four cognitive synthesis groups appeared to use predominantly sentence and beyond sentence level information.

Comprehension Proficiency. The analyses of the cognitive synthesis data reported earlier in Chapter 5 revealed that the Very Proficient readers were found predominantly in the High Successive-High Simultaneous, and Low Successive-High Simultaneous groups. This confounding of the subjects' performances on the cognitive synthesis tests with their reading comprehension proficiency necessitated careful examination of the data in terms of the two comprehension proficiency groups (n=20) to adequately interpret the findings reported earlier in

Table 6.5 KIND OF TEXTUAL INFORMATION USED BY COGNITIVE SYNTHESIS GROUPS TO GENERATE INFERENCES

1. Percentage of Forward-Looking Inferences Generated From

Group	Word	Sentence	Beyond Sentence
HH (50)	14	58	28
HL (44)	14	59	27
LH (49)	8	63	29
LL (69)	12	62	26

2. Percentage of Backward-Looking Inferences Generated From

Group	Word	Sentence	Beyond Sentence
HH (46)	9	39	52
HL (33)	9	36	55
LH (45)	4	56	40
LL (32)	16	47	37

(total number of inferential responses appears in brackets after each group)

HH = High Successive - High Simultaneous
HL = High Successive - Low Simultaneous
LH = Low Successive - High Simultaneous
LL = Low Successive - Low Simultaneous

this chapter.

In this section the findings related to the analysis of the relationships between comprehension proficiency, kind of inference, use of textual support, and kind of information used to generate inferences will be presented. An independent t-test was used to compare the Very Proficient with the Less Proficient Readers.

To provide sufficiently stable data for this test, the subcategories of "supported" and "non-supported" were collapsed for each of the kinds of inference. The two proficiency groups were then compared first on forward-looking inferences and then on backward-looking inferences. The findings revealed no significant differences in terms of the quantity generated for either forward-looking (t(38)=.049;p=.961), or backward-looking (t(38)=.582;p=.564) inferences. The reader is referred to Table 6.6 for a summary of these findings.

Table 6.6 t-TESTS: VERY PROFICIENT AND LESS PROFICIENT READERS ON ORIT

	Very Proficient $\overline{X}$	(s.d.)	Less Proficient $\overline{X}$	(s.d.)	t	df	prob.
FLI*	55.45	(15.45)	55.05	(33.05)	.049	38	.961
BLI**	44.5	(15.45)	39.95	(31.83)	.582	38	.564
Supported Inferences	83.3	(15.70)	66.85	(30.44)	*2.119	38	.038

*FLI= Forward-Looking Inference **BLI= Backward-Looking Inferences

Following the procedure outlined above, the subjects' percentage scores were then collapsed across the two kinds of inference into supported and non-supported categories. The t-test for the comparision of the two proficiency groups on the aspect of support revealed signifcance (t(38)=2.119;p=.038). Inspection of the means revealed that the Very Proficient ($\overline{X}$=83.3) achieved a higher mean percentage score for supported inferential responses than the Less Proficient ($\overline{X}$=66.35). The analysis also revealed that the scores of the Very Proficient (s.d.=15.45) varied less than the scores of the Less Proficient (s.d.= 30.05) subjects. See Table 6.4 for a summary of these findings.

The procedures used to determine the percentage scores of the subjects' forward and backward-looking inferences created a dependent relationship between the two scores. Thus, correlated t-tests could not be used to explore the observed differences within each of the two levels of reading proficiency. Therefore, the Signs Test again was applied to determine whether there were significant differences in the observed number of supported and non-supported forward and backward-looking inferences generated by the two levels of reading proficiency.

The comparison of support and non-support for the forward-looking inferences revealed a significant difference for the Very Proficient (19,0:p=.000), but not for the Less Proficient (15,4:p=.118). These findings have been summarized in Table 6.7. An inspection of the signs for the Very Proficient revealed that they generated more supported than non-supported forward-looking inferences on ORIT.

In terms of supported/non-supported backward-looking inferences, both the Very Proficient (20,0:p=.000) and the Less Proficient (15,1: p=.000) revealed significant differences. An investigation of the signs indicated that both groups had generated significantly more supported than non-supported backward-looking inferences.

In the forward-looking/backward-looking inference comparisions,

Table 6.7 SIGN TESTS SUMMARY: PROFICIENCY GROUPS ON ORIT

	Probability FLI:S/NS	BLI:S/NS	FLI/BLI
Very Proficient (17,4)	.000	.000	.05
Less Proficient (18,8)	.118	.000	.814

FLI:S/NS Forward-Looking Inferences: Supported/Non-Supported
BLI:S/NS Backward-Looking Inferences: Supported/Non-Supported
FLI/BLI Forward-Looking Inferences/Backward-Looking Inferences

the Signs Tests revealed a significant difference for the Very Proficient (17,4:p=.05), but not for the Less Proficient (18,8:p=.814) Readers. Inspection of the signs indicated that the Very Proficient had generated more forward-looking inferences.

A comparision of the two comprehension proficiency groups in terms of the kinds of information used to generate inferences revealed that both levels of proficiency were using predominantly sentence level and beyond sentence level information in the generation of their inferences. A summary of the percentage of inferences generated at the word, sentence, and beyond sentence levels has been provided in Table 6.8.

Discussion. The findings of these analyses indicate that the introspective responses made of these subjects while orally reading continuous discourse reflect inferential comprehension at both levels of reading proficiency. This finding is in agreement with previous studies by Simpson (1976), Paris and his Associates (1973, 1974, 1974, 1975), Piekarz (1954), and Jenkinson (1957) who reported that inferences were included in maturing readers' comprehension.

Table 6.8 KIND OF TEXTUAL INFORMATION USED BY READING PROFICIENCY GROUPS TO GENERATE INFERENCES

1. Percentage of Forward-looking inferences generated from

Group	word	sentence	beyond sentence
VP(116)	12	60	28
LP(96)	10	62	28

2. Percentage Backward-looking inferences generated from

Group	word	sentence	beyond sentence
VP(93)	7	48	45
LP(63)	13	40	47

(total number of inferential responses appear in brackets after each group)

VP - Very Proficient Group
LP - Less Proficient Group

Simpson's observations were based on children's oral story telling of a picture story book. The present study extended the systemmatic observation of the generation of inferences as part of comprehension to written continuous discourse. From her observations of subjects from kindergarten to grade four, Simpson observed an increase in inaccurate inferences among the low achieving readers. From the analyses of ORIT, it would appear that the Less Proficient readers tend to make more of the errors on forward-looking inferences.

The earlier studies of Piekarz (1954) and Jenkinson (1957) had reported a significantly greater number of inaccurate interpretive responses among the Less Proficient subjects. This more global category of interpretive responses included inferences. Again the present findings seem to indicate that the Less Proficient reader generated more inaccurate forward-looking inferences. However, these same subjects generated significantly more supported than non-supported backward-looking inferences. This finding suggests that the forward and backward-looking inferences are different in nature, and make different demands on the maturing reader.

Piekarz (1954) and Jenkinson (1957) reported that the Very Proficient readers made greater use of contextual information to support their interpretive responses. The present study gives added support to this observation. In the case of both forward and backward-looking inferences, the Very Proficient readers made significantly greater use of textual information to support the generated inferences.

Paris and Upton (1974) reported that the kind of inference (contextual vs lexical) was a significant determiner of the subjects' performance scores on inference questions. It was reported that the students found the contextual inferences significantly more difficult. From their description of contextual inferences, it would appear that the category included both forward ("probable conclusions of a series of statements") and backward ("pre-existing conditions necessary to make a sentence or paragraph true") inferences. The analysis of the ORIT indicate that both proficient and less proficient grade four students generate both backward and forward-looking inferences. Although the mean percentage of forward-looking inferences was greater than the backward-looking inferences for both levels of proficiency, the degree of difference was significant for only the Very Proficient.

When the subjects' scores on ORIT were analyzed in terms of membership in the four previously identified cognitive synthesis groups, only the category of supported inferences revealed the High Successive-High Simultaneous group as most successful, and the Low Successive-Low Simultaneous group as least successful as has been reported in previously cited studies by Leong (1974) and Kirby and Das (in press). For the other two groups (High Successive-Low Simultaneous, and Low-Successive-High Simultaneous), Kirby and Das reported no significant difference with each attaining moderate achievement. However, in the present study the Low Successive-High Simultaneous group was significantly superior in their combined performance than the High Successive-Low Simultaneous. This finding reflects the significant interaction between reading proficiency and cognitive synthesis groups reported in Chapter 5. In the comparision of the performances of the four groups on the supported inferences, the simultaneous synthesis appears to distinguish the levels of performance. This finding gives support to Latham's (1973) conclusion that simultaneous synthesis is significantly related to reading comprehension.

The other two categories of the present analysis which were submitted to statistical tests of significance were those of Forward-looking inferences, and Backward-looking inferences. The comparisions of these two categories were based on frequency counts transformed into percentages for each subject without consideration of acceptability of the response. Thus, the analyses reflect quantitative rather than qualitative generation of the respective inference types. In these two comparisons, the group performances varied from the order reported above. Figure 6.2 graphically demonstrated the ranked order of the cognitive synthesis groups from highest to lowest for the present study.

Rank Order	Forward-Looking Inferences	Backward-Looking Inferences
1	High Successive-Low Simultaneous	Low Successive-High Simultaneous
2	Low Successive-Low Simultaneous	High Successive-High Simultaneous
3	High Successive-High Simultaneous	High Successive-Low Simultaneous
4	Low Successive-High Simultaneous	Low Successive-Low Simultaneous

Figure 6.2 COGNITIVE SYNTHESIS GROUPS RANKED BY MEAN NUMBER OF TWO KINDS OF INFERENCE

From these observed rankings, it was noted that neither the generation of forward-looking inferences, nor the generation of backward inference on a self-structured task were the same as the Kirby-Das findings. The differences in these findings would appear to be attributable to the quantitative basis of comparision in the present study, and again the significant interaction between the cognitive synthesis groups and reading proficiency. However, an inspection of the rankings on the latter two categories reveals that the two top groups and the two bottom groups in each ranking are distinguished in terms of simultaneous but not successive synthesis performance. This was interpreted as further support for Latham's position that reading comprehension and simultaneous synthesis are significantly related.

STORY-RECALL INFERENCE TASK

Immediately after the completion of the ORIT, the stimulus story was taken from the subject. He was then asked to retell the story from memory. In the previously discussed studies by Paris and his associates (1973, 1974, 1974, 1975), it was found that children could not discriminate between textual information and true inferences. From this finding the researchers concluded that the subjects generated inferences as part of the memory structure. The present task was designed to see whether they reported inferences as part of their story recall. The oral retelling of the story was tape recorded, and later transcribed to a written protocol. These protocols were analyzed to identify the inferences, and to determine whether the reported inferences were backward-looking or forward-looking. This section will first describe the system used in the qualitative analyses of the transcribed SRIT protocols. This will be followed by the analyses and findings. A summary discussion will conclude this section.

Qualitative Analyses Categories

The category system used in the analyses of the SRIT protocols was modified from the ORIT classification system and reflected the same dichotomous decision making procedures. It was composed of four levels of analyses. These corresponded to the first four levels of the ORIT system. No attempt was made to classify the word, sentence, and beyond sentence information identified in Levels 5 and 6 of the ORIT analysis. A schematic representation is given in Figure 6.3.

Level 1: Textual Recall - Non Textual Recall. The first level of the analyses of the SRIT protocols involved the classification of the protocol into either "Textual recall" or "Non-textual recall". The following examples will illustrate this division. "The non textual recall" has been identified by braces.

Subject #10: {First, you know,} the dog can't talk. {..so...um} he has to bark for everything. And he had to bark to

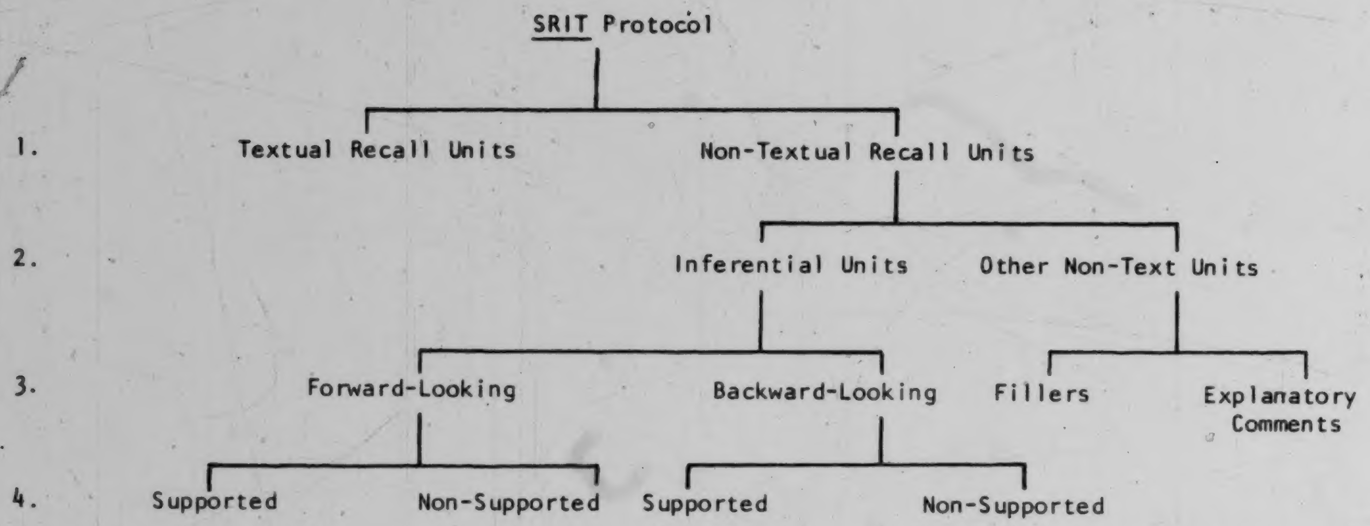

SRIT Protocol
1.
Textual Recall Units
Non-Textual Recall Units
2.
Inferential Units
Other Non-Text Units
3.
Forward-Looking
Backward-Looking
Fillers
Explanatory Comments
4.
Supported
Non-Supported
Supported
Non-Supported

Figure 6.3 DICHOTOMOUS CATEGORIES USED IN QUALITATIVE ANALYSES OF SRIT

to go out. And he had to bark for something to eat. {But then it all started this night when everyone was sleeping ...}

Subject #37: Miss Bella really likes animals. And then one day she heard some shots {from a shotgun}. And then she went to try and get, {you know} get away the unwelcome visitors. They had completely ignored her...

Level 2: Inferential/Non Inferential Units. At level two of the SRIT analysis, the non-textual recall units were identified as either an inferential unit, or as a non-inferential unit. The following examples illustrate the two kinds of responses. In these examples, the inferential units are indicated within square brackets, and the non-inferential units have been identified within round brackets.

Subject #24: ...She told the clerk that she had taken up shooting, and that she had her license. And all she needed now was a shotgun and some bullets {[So she bought them] (and that)} . And when she took the gun, she was kinda shaky {[And she went out]} And the news went...spread way over town...

Subject #2: ...And they could see the fire in the living room and everywhere. {(And umm..)} They finally went...got outside. And the kids huddled together. And the firemen came. And some men ordered the hoses. {(And everything) (to umm)..(to umm)} ..get the fire out of the house...

Subject #11: ...Still every day she went to the mud bank of the creek and fired a couple of shots into it {[So the hunters would think she was shooting game]} . And if she ever saw a hunter, she would wave her gun at him as though she thought he was game. And that hunter was always quick to leave. And finally no hunters came at all to Miss Bella's farm {[because they were scared she might do something, and by mistake kill someone]} ...

Level 3. At this level two dichotomous decisions had to be made. The first decision involved the classification of each of the inferences identified in level 2 as either forward-looking or backward-looking. The other decision involved the non-inference units which were now categorized as "filler responses" or explanatory comments.

First the division of inferences into either the forward-looking or backward-looking category will be illustrated. In these examples, the forward-looking inferences are underlined with a broken line, and the backward-looking inferences underlined with a solid line.

Subject #5: One day she heard a gun fire shot {[and she wondered what was killed.]} --a red squirrel or a pheasant?...

Subject #33: ...Follow Scotty, he'll lead us out of the house if we follow him. {[They rushed down the stairs]} and could see all the kitchen was ablaze...

Subject #34: ...And a gas station {[on the way, halfway between her house and the other town]} was telling all the hunters to watch out cause she was short sighted...

Subject #13: ...and he started really barking, really bad. {[And Dad was mad.]} So he yelled for him to be quiet. And he kept on barking [So finally he flew out of bed] [and he started getting really mad] ...

The following examples illustrate the division of the non-inference units into fillers and explanatory comments. Most of the fillers were produced by the Less Proficient Readers. Very few explanatory comments were made. First the fillers will be illustrated. They have been bracketed to separate them from the textual units.

Subject #6: ...The gun was shaking in her hands {(you know)} like leaves. {(And...umm...)} Like she picked it up and she looked through her {(mmm)} glasses. She told the clerk she already had {(...umm...)} she went to the other town. She already said that she had her hunting permit. And all she need now was a gun {(...and umm...)} some shells...

Subject #24: ...And when hunting season came she would hear all the shots and just shiver {(you know)} She really loved the animals. And she put hunting signs up {(and all that)} But they didn't pay any attention...

Subject #2: ... {(And..umm)} finally the house was saved. {(And ..umm)} Cindy told Scotty that {(..umm...)} that he had saved their lives.

In the following examples explanatory comments are illustrated. These have been bracketed.

Subject #14: ...She went over to this hardware store in Riverside. {(I think it was)} And she bought a gun...

Subject #5: ...And the birds were happily singing in their flocks. And the animals got ready for winter. {(And that's all I can remember.)}

Subject #19: ...The barrel was shaking in her hand, and the clerk wiped the back of his hand on his forehead. {(I remember another part too)} The news spread that Miss Bella was taking up hunting {(And the last part I remember)} Every day Miss Bella...

Level 4: Supported/Non Supported Inferences. At the fourth level of the SRIT analyses the inferential responses classified as either forward-looking or backward-looking were further analyzed into either textually supported or non-supported. This analysis was carried out for both the categories of forward and backward-looking inferences. In the following examples the forward-looking inferences are indicated by broken underlining, while backward-looking inferences are underlined with a solid line. Support has been indicated by a "c" placed above the response. Non support has been shown by an "x" above the response. The first examples are of forward-looking inferences.

Subject #2: ...And Scotty ran down the stairs waiting for them {[And they $\overset{c}{\text{got}}$ everyone together]} And they started going downstairs...

Subject #34: ...And whenever people get sick, she goes to their house, like a neighbour's house. { [And $\overset{c}{\text{then}}$ it came fall]}

Subject #7: ...And they all fell on the lawn. {[And when they $\overset{x}{\text{went}}$ out a whole bunch of neighbours were shouting]}...

Subject #24: ...And the news went - spread way over town and everything quite fast. {[And they warned $\overset{x}{\text{her}}$ that she was really near sighted, that she might mistake the hunters for game.]}

The following examples are illustrative of supported and non-supported backward-looking inferences. The same identification system has been used.

Subject #2: ...One night {(umm)..[when $\overset{c}{\text{everyone}}$ was in bed]} he started..umm...barking quite a bit...

Subject #14: ...She told the clerk that she was going to go hunting. {[And her plan was to scare^{c} all the hunters away.]}

Subject #19: Miss Bella went to Riverside {[to get some^{x} groceries]}..

Subject #26: Scotty was the Brown's pet. And..he..umm.. {[he was ^{x}upset because he couldn't talk.]}

Reliability of the Classification Categories

As in the case of the ORIT, six SRIT protocols were randomly selected and checked by two independent judges to establish the inter-rater reliability of the classification system. Coefficients of reliability were computed as previously described (See Chapter 4). These coefficients have been summarized in Table 6.9.

In these comparisons the overall inter-rater reliability did not fall below .94. Within the four levels the lowest observed coefficient was .83. This was computed for the "non-supported" forward-looking inference category. In light of the complexity of the system, the levels of agreement were felt to be very acceptable.

Findings: Qualitative and Quantitative Analyses

The qualitative analyses of the SRIT protocols were based on the previously described classification system which was modified from the ORIT system of analysis. Frequency counts were made of each of the categories after all protocols had been analyzed and checked. Summary tables were prepared from these observations for each of the four cognitive synthesis groups. See Appendix F, pages 313 to 317.

Inspection of these summaries revealed that a total of 167 inferential responses were identified in the SRIT protocols of the forty subjects. Of these 81/167 or 49% were categorized as forward-looking inferences. Within this category 43/81 or 53% were judged to be

Table 6.9 INDEPENDENT COEFFICIENTS OF AGREEMENT: SRIT CLASSIFICATION SYSTEM (SIX PROTOCOLS)

Levels of Analysis	I & J_1	I & J_2	J_1 & J_2
1. Textual Units	1.0	1.0	1.0
Non-Textual Units	1.0	.95	.98
2. Inferential Units	.92	.88	.92
Non-Inferential Units	1.0	1.0	1.0
3. Forward-Looking	.88	.88	.94
Backward-Looking	1.0	.94	.94
Fillers	1.0	1.0	1.0
Explanatory Comments	1.0	1.0	1.0
4. Supported FLI	1.0	.95	.95
Non-Supported FLI	.83	.83	1.0
Supported BLI	1.0	.95	.95
Non-Supported BLI	1.0	1.0	1.0
Total	.98	.94	.96

I = Investigator

J_1 = Judge 1

J_2 = Judge 2

textually supported, and 38/81 or 47% were considered not textually supported. For the category of backward-looking inferences, 81/167 (51%) were observed. When this sub-category was analyzed for textual support, 84/86 (97%) were found to be supported, and only 2/86 (3%) were judged to be not supported. Inspection of the percentage scores seemed to indicate that the Backward-looking inferences were more consistently supported than the Forward-looking inferences on the subjects' SRIT protocols. As for the ORIT data, statistical analyses were made of the SRIT data first in terms of the four cognitive synthesis groups, and second according to the two levels of reading proficiency.

Cognitive Synthesis Groups. The transformed percentage scores of the subjects in each of the categories of the SRIT analyses were used to compute means and standard deviations for the four cognitive synthesis groups. A summary of these computations has been presented in Table 6.10.

Table 6.10 PERFORMANCE ON SRIT BY COGNITIVE SYNTHESIS GROUPS MEANS AND STANDARD DEVIATIONS

	FLI[2]		BLI[3]		SIR[4]		Recall[5]	
Group[1]	$\overline{X}$	(s.d.)	$\overline{X}$	(s.d.)	$\overline{X}$	(s.d.)	$\overline{X}$	(s.d.)
HH	62.5	(34.78)	37.5	(34.78)	77.5	(32.16)	35.9	(22.49)
HL	50.8	(23.48)	49.2	(23.48)	67.5	(23.50)	30.1	(11.69)
LH	52.1	(35.62)	47.9	(35.62)	81.2	(23.02)	35.0	(9.61)
LL	32.3	(27.80)	67.7	(27.80)	79.7	(28.80)	27.9	(16.09)

[1] HH = High Successive-High Simultaneous; HL=High Successive-Low Simultaneous; LH=Low Successive-High Simultaneous; LL=Low Successive-Low Simultaneous

[2] FLI = Forward-Looking Inferences

[3] BLI = Backward-Looking Inferences

[4] SIR = Supported Inferential Units

[5] Recalled Units based on Story units identified in story grammar analyses

To test whether the observed differences were statistically significant in terms of the cognitive synthesis groups, the data were submitted to a 2X2 analysis of variance where the main effects were successive and simultaneous synthesis. For the forward-looking inference, this test indicated no significant main effect due to either successive $(F(1,36)=2.195;p=.15)$or simultaneous synthesis $(F(1,36)=2.608;p=.12)$. Nor was the interaction effect significant $(F(1,36)=.172;p=.68)$. Similar findings were revealed for the backward-looking inferences. There was no significant main effect due to successive synthesis $(F(1,36)=.2195;p=.15)$, or to simultaneous synthesis $(F(1,36)=2.608;p=.12)$, and no significant interaction $(F(1,36)=.172;p=.68)$. Also, for the supported category there were no significant differences due to successive $(F(1,36)=.857;p=.36)$ or simultaneous $(F(1,36)=.448;p=.51)$ synthesis, or interaction $(F(1,36)=.245;p=.62)$. When story recall was analyzed, no significant main effects due to successive $(F(1,36)=.097;p=.76)$ or simultaneous $(F(1,36)=1.674;p=.20)$ synthesis were revealed - nor was the interaction significant $(F(1,36)-.017;p=.89)$. Table 6.11 summarizes these findings.

A Signs Test was used to check the observed differences for each of the dichotomous categories within each cognitive synthesis group. When the quantitative generation of Forward-looking/Backward-looking inferences was compared, the tests revealed no significant difference for each of the four cognitive synthesis groups. As well, no significant differences were revealed for the supported/non-supported forward-looking inference comparisions. However, the Signs Tests revealed significant differences between the supported and non-supported backward-looking inferences for each of the cognitive synthesis groups.

Table 6.11 ANALYSIS OF VARIANCE SUMMARY TABLES: SUCCESSIVE (A) X SIMULTANEOUS (B) SYNTHESIS FOR SRIT

1. Variable: Forward-Looking Inferences

Source	S.S.	df	M.S.	F-Ratio	Prob.
A	2,088.0	1	2,088.0	2.195	.15
B	2,480.63	1	2,480.63	2.608	.12
AB	164.06	1	164.06	.172	.68
SE	34,235.1	36	950.97		

2. Variable: Backward-Looking Inferences

Source	S.S.	df	M.S.	F-Ratio	Prob.
A	2,088.0	1	2,088.0	2.195	.15
B	2,480.63	1	2,480.63	2.608	.12
AB	164.06	1	164.06	.175	.68
SE	34,235.1	36	950.97		

3. Variable: Supported Inferences

Source	S.S.	df	M.S.	F-Ratio	Prob.
A	632.00	1	632.00	.857	.36
B	330.50	1	330.50	.448	.50
AB	180.56	1	180.56	.245	.62
SE	26,526.8	36	736.85		

4. Variable: Story Units Recalled

Source	S.S.	df	M.S.	F-Ratio	Prob.
A	24.043	1	24.043	.097	.76
B	416.051	1	416.051	1.674	.20
AB	4.219	1	4.219	.017	.89
SE	8,946.71	36	248.520		

Inspection of the signs revealed that the significant difference was in favour of the supported category. A summary of Signs Tests for these three comparisions has been provided in Table 6.12.

Table 6.12 SIGN TESTS SUMMARY TABLE: COGNITIVE SYNTHESIS GROUPS ON SRIT

Basis of Comparison	Group[1]	Probability			
		HH	HL	LH	LL
FLI/BLI		(9,3) .508	(9,4) 1.0	(10,5) 1.0	(8,2) .290
FLI:S/NS		(8,2) .290	(10,3) .344	(9,3) .508	(7,3) 1.0
BLI:S/NS		(7,0) .016	(8,0) .008	(7,0) .016	(10,0) .002

(the number of signs is given in brackets for each comparison)

FLI - Forward-Looking Inference
BLI - Backward-Looking Inference
S - Supported
NS - Not Supported

Reading Proficiency Levels. As in the analyses of ORIT, in order to compare the two reading proficiency levels, the sub-categories of "supported" and "non-supported" were collapsed within each of the forward and backward inference categories. The means calculated on these combined data indicated that the Very Proficient subjects ($\bar{X}$=58.3;s.d.=33.73) attained a higher mean percentage score on the quantity of forward-looking inferences than the Less Proficient subjects ($\bar{X}$=40.55;s.d.=27.33). In contrast, the Less Proficient ($\bar{X}$=59.45;s.d.=27.33) attained a higher mean score than the Very Proficient ($\bar{X}$=41.7;s.d.=33.73) on the quantity of backward-looking inferences. To test if these differences were statistically significant, the data in each category were submitted to independent t-tests.

When these comparisons were computed, it was revealed that there were no significant differences for either the forward-looking inferences (t(38)=1.828;p=.075), or backward-looking inferences (t(38)=1.828;p=.075) in terms of the quantity generated.

Next the subjects' scores were collapsed across the two kinds of inference into the "supported" and "non-supported" categories. When means were calculated on these combined data, it was revealed that the Very Proficient had a mean percentage score of 84.3(s.d.=26.62) and the Less Proficient obtained a mean of 68.6 (s.d.=24.84). When the observed difference between the Very Proficient and Less Proficient Readers in terms of the overall number of textually supported inferences was submitted to an independent t-test, the resulting t indicated that the difference was not statistically significant (t(38)=1.93;p=.06). However, a comparison of the two levels of reading proficiency based on the quantity of story units recalled in the SRIT protocol revealed that the Very Proficient ($\bar{X}$=38.95;s.d.=17.04) were significantly higher (t[38]=3.01);p=.005) than the Less Proficient ($\bar{X}$=25.50;s.d.=10.43). A summary of these findings is presented in Table 6.13.

The transformation procedures for changing the frequency score to percentages again created a dependency between the categories of forward- and backward-looking inferences, and between the "supported" and "non-supported" sub-categories. Thus, the correlated t-test could not be used, and the non parametric Signs Test was used once again in its stead to determine whether observed differences were significant. A summary of the findings revealed by these tests is given in Table 6.14.

In the supported/non-supported forward-looking inference comparison, the Signs Test revealed a significant difference between the quantity of

Table 6.13 t-TESTS: VERY PROFICIENT AND LESS PROFICIENT READERS' ON SRIT

	Very Proficient		Less Proficient				
	$\overline{X}$	(s.d.)	$\overline{X}$	(s.d.)	t	df	prob.
FLI*	58.3	(33.73)	40.55	(27.33)	1.828	38	.075
BLI**	41.7	(33.73)	59.45	(27.33)	1.828	38	.075
Supported Inferences	84.35	(26.61)	68.6	(24.84)	1.934	38	.060
Story Recall	38.95	(17.04)	25.50	(10.43)	3.011	38	.005

*FLI= Forward-Looking Inference **BLI= Backward-Looking Inference

Table 6.14 SIGN TESTS SUMMARY TABLE: READING PROFICIENCY LEVELS ON SRIT

Category of Comparison	Probability		
	FLI:S/N*	BLI:S/N**	FLI/BLI***
Very Proficient	.012	.000	.648
Less Proficient	.096	.000	.238

FLI:S/NS Forward-Looking Inference: Supported/Non-Supported
BLI:S/NS Backward-Looking Inference: Supported/Non-Supported
FLI/BLI Forward-Looking Inference / Backward-Looking Inference

inferences generated which were supported and non supported for the Very Proficient (17,3:p=.012), but not for the Less Proficient (18,5: p=.096). When the direction of the signs was investigated for the Very Proficient, it was found that these subjects generated significantly more supported than non-supported forward-looking inferences.

Likewise, the Signs Tests revealed a significant difference between the quantity of supported and non-supported backward-looking inferences for the Very Proficient (15,0:p=.000), and in this comparison also for the Less Proficient (18,0:p=.000). In both comparisons, inspections of the signs revealed significantly more supported than non-supported backward-looking inferences had been generated. There were no significant differences for either the Very Proficient (19,8:p=.648) or the Less Proficient (17,6:p=.239) in terms of the total number of forward/backward-looking inferences generated.

Discussion. Both forward-looking and backward-looking inferences were identified in the qualitative analyses of the story recall protocols. This finding gives additional support based on children's actual generation of inferences to previous work by Paris and Carter (1973) and Paris and Mahoney (1974) who concluded from discrimination tasks that inferences were generated as part of "story" memory. The present analyses extend this finding to continuous written discourse.

The SRIT analyses give addition support to the suggestion that forward and backward inferences make differing demands on the reader. This is based on the finding that all cognitive synthesis groups generated significantly more supported than non-supported inferences. However, for the forward-looking inferences only the high simultaneous-high successive group generated more supported than non-supported inferences. This finding is in keeping with the observations of Piekarz (1954), Jenkinson (1957), and Letton (1958) that Very Proficient Readers were more aware of the textual contraints than Less Proficient Readers. The finding that the two types of inference are handled at differing levels of proficiency is in keeping with Paris and Upton's (1974) observation that the kind of inference is a factor in determining success with inferences.

The quantitative generation of forward and backward-looking inferences by these grade four children indicate no significant differences for all four cognitive synthesis groups, and for the Very Proficient and Less Proficient Readers. It would appear that factors other than cognitive synthesis may be influential in determining the quantity of inferences generated. It is hypothesized that the cognitive processes associated with Lurias' block three, namely, formations of intentions and programs, and decision making may be critical. This will be discussed further in Chapter 7.

DIRECTIONAL-QUESTION INFERENCE TASK

The third and final reading related task was the Directional-Question Inference Task (DQIT). In this task the subject had the story in front of him or her, and was required to respond to ten orally presented questions. Five of these required forward-looking inferences for answers, and five required backward-looking inferences. The subjects' oral responses were tape recorded and later transcribed into typed protocols. These were analyzed by the investigator. The data generated by the qualitative analyses were submitted to a 2X2 analysis of variance to determine the effects of the two kinds of synthesis. In this section the qualitative and quantitative analyses will be described. The findings will be reported and discussed in light of the previous research.

Categories For Qualitative Analyses

Since this study attempted to explicate how the Very Proficient and Less Proficient Readers process textual materials to generate inferences, it was decided that the subjects' responses would not be simply scored right or wrong. Rather a three category system was devised by the investigator to guide the scoring of each subject's responses to the ten directional questions.

DQIT Scoring System

The scoring system used in the analysis of the DQIT responses was based on the previous research of Laing (1974), who noted that an arbitrary classification of responses as correct or incorrect did not reflect how subjects responded. The present system was composed of three categories. These categories were identified as (1) Response, (2) Support, and (3) Verbalized Linkage.

In the Response analysis, the subject's initial response was used. This response was scored one if it were an acceptable response within context of the stimulus story. If the response was not acceptable it was given a zero. This was the only category scored one or zero.

The Support category was concerned with the textual support the subject used in responding to the stimulus question. Each subjects' response was scored two, one or zero for support. A two was given for convincingly clear, concise textual support. A one was assigned for partial textual support, and zero was given for no textual support, or incorrect textual information for support.

In the Verbalized Linkage category, each response was judged on the basis of the linkage the subject indicated for the support with the response. Clearly expressed linkage was rated two. A one was given for partial, or attempted but poorly expressed linkage, and a zero was assigned for no expressed linkage, or incorrect linkage.

Thus, each stimulus question was scored out of five possible points. For both the forward-looking, and backward-looking inferences there were five questions. In each sub-category there was a possible score of twenty-five. The total inference score was out of fifty. These raw scores were transformed into percentages before the quantitative analyses were performed.

Illustrative Examples

In this section examples have been provided to illustrate the scoring system used in the DQIT analysis. Only two questions have been used in the examples to facilitate comparisions for the reader.

Responses Rated as Five. The following responses were awarded the full allowable points in each of the three categories. In each, the response was acceptable. The support was stated with clarity and precision, and so was the verbalized linkage. In these examples, the researcher has been designated by R and the subject by S.

Subject #25:

R: How did Father feel toward Scotty at the beginning of the story?

S: He was annoyed at Scotty. He kept barking.

R: What makes you think that?

S: Well it says [subject reads from text] "This barking tonight was too much. It was the middle of the night, and if Scotty kept on he would wake every member of the Brown family.

R: Is there anything else?

S: No.

Subject #11:

R: What kind of transportation did the visiting hunters use in order to reach Miss Bella's farm?

S: Well, I don't really know. Well, let's see now. They must have used cars because it says [subject reads] "The fellows at the service station told the visiting hunters who stopped for gas." So they must have stopped for gas for their cars, or maybe motorcycles, at the service station.

R: Is there anything else?

S: I don't think so. No.

Responses Rated Four. In the following examples, although the initial response has been rated as acceptable, the textual support or verbalized linkage have not been expressed with the same precision and clarity.

Subject #26:

R: How did Father feel toward Scotty at the beginning of the story?

S: Well he wanted him to be quiet.

R: How did he feel?

S: Mad.

R: Why do you think he was mad?

S: Cause he was shouting.

R: Is there anything else?

S: Not that I can think of.

Subject #19:

R: What kind of transportation did the visiting hunters use in order to reach Miss Bella's farm?

S: Car.

R: What makes you think that?

S: Well when it said that the gas station... they told the visiting hunters about Miss Bella's new hobby when the visitors came through his gas station.

R: Is there anything else?

S: No.

Responses Rated Three. In these examples the response is rated as acceptable. However, both the stated support and verbalized linkage are not expressed as precisely. As well, extraneous information is often introduced in either or both of these categories.

Subject #27:

R: How did Father feel toward Scotty at the beginning of the story?

S: Well, he didn't really like it when he was barking.

R: Why do you think that?

S: Cause he would always awaken the family.

R: Is there anything else?

S: Well, he's be barking so much, and he would be trying to... the mother and the father would be trying to read the Journal or something, and he would be interupting them.

Subject #18:

R: What kind of transportation did the visiting hunters use in order to reach Miss Bella's farm?

S: Cars.

R: How do you know that?

S: It says right here [reading] "Service Station". So they must have been on cars, or bicycles or something.

R: Which do you think it was - a car or a bicycle?

S: Probably a car cause you have lots of equipment when you hunt.

R: Is there anything else?

S: No.

Responses Rated Two. In these examples, although the initial response is again acceptable, either the subject's statement of textual support, or the verbalized linkage has been judged as unacceptable.

Subject #3:

R: How did Father feel toward Scotty at the beginning of the story?

S: Oh he was mad at him because he was just waking up.

R: Why do you think that?

S: Because he was yelling at him to stop barking.

R: Is there anything in the story that makes you think that?

S: Well, he yelled at him [reads] "Quiet Scotty".

Subject #28:

R: What kind of transportation did the visiting hunters use in order to reach Miss Bella's farm?

S: Maybe a car?

R: Why do you think that?

S: Well it might be a long way from the city.

R: Is there anything else?

S: Maybe they could have walked.

R: Which do you think - did they walk or come by car?

S: Car.

R: Why do you think they came by car?

S: It might be a long, long way to walk.

R: Is there anything in the story that makes you think they came by car?

S: Well, when the visitors came to shoot, they could have come from a long, long way. And they wouldn't walk that way, because its too far to walk.

Responses Ranked One. In these examples, the response was judged acceptable in the context of the story. However, the statement of textual support, and the verbalized linkage were not acceptably expressed.

Subject #20:

R: How did Father feel toward Scotty at the beginning of the story?

S: Well, sorta mean like, you know, mad.

R: Why do you think that?

S: Cause he was sorta yelling at him?

R: Is there anything in the story that makes you think he was yelling at him?

S: ...well sorta... no, not really.

R: Do you think father felt mean toward Scotty when he yelled at him?

S: Yeah.

Subject #1:

R: What kind of transportation did the visiting hunters use in order to reach Miss Bella's farm?

S: They either used, like they really wouldn't want to walk cause they had the guns. And if they lived a little ways away they wouldn't want to walk there, and walk all the way back with an animal if they shot one.

R: So how would they go?

S: They'd probably either go by car or...probably by car.

R: Why do you think that?

S: Because if they had all the supplies they wouldn't just want to shoot an animal and take it and walk home with it... with an animal like that...with blood all over the place. So they'd probably use something to clean it. And then they needed the gun to shoot it. And they wouldn't really want to walk down there with a whole bunch of stuff and walk back with a rabbit or peasant or something in their hands with blood.

R: Is there anything in the story that tells you that they might have come by car?

S: Not really, I don't think so. But it just sorta tells you that they wouldn't come by anything else like.

Responses Ranked Zero. In the following examples, none of the three categories of analysis was judged to be acceptable. In these responses the subjects' experiential background overshadowed the story context. The responses reflected, in some case, what Piaget has classified as egocentric thinking.

Subject #40:

R: How did Father feel toward Scotty at the beginning of the story?

S: Well, he was a nice dog.

R: Is there anything in the story that makes you think that?

S: No.

R: What makes you think so then?

S: Well I think he's a good dog. I like dogs.

R: What makes you think he was a good dog.

S: It just sounded like he was.

R: What part did you read that sounded like he was a good dog?

S: I don't know. [at this point the subject was becoming visibly irritated, so no further probe questions were asked.]

Subject #22:

R: What kind of transportation did the visiting hunters use in order to get to Miss Bella's farm?

S: Horse.

R: Is there something in the story that makes you think they came by horse?

S: No they might have walked.

R: What part tells you that they walked?

S: It didn't, it just says they left quickly.

R: How did they come then?

S: By horse.

R: Why do you think that?

S: I don't know [becoming irritable] cause most hunters usually come on horses.

R: How do you know that?

S: Cause whenever me and my cousin go we always go by horse.

The rating of the subjects' responses was a very subjective procedure. Therefore, the category system was examined for inter-rater reliability. This will be discussed in the next section.

Reliability of Classifications

In order to establish the inter-rater reliability of the three category analysis system, ten DQIT protocols were randomly selected and checked by two independent judges. The same procedures were followed as have been described previously for ORIT and SRIT. Reliability coefficients were calculated for each category. These have been summarized in Table 6.15.

Table 6.15 INDEPENDENT COEFFICIENTS OF AGREEMENT: DQIT CLASSIFICATION CATEGORIES (TEN PROTOCOLS)

	I & J_1	I & J_2	J_1 & J_2
Response	1.00	.98	.98
Textual Support	.91	.93	.93
Verbalized Linkage	.94	.90	.93
Total	.95	.93	.95

I = Investigator J_1 = Judge 1 J_2 = Judge 2

For overall reliability the coefficients did not drop below .93. In the case of the individual categories, the coefficients did not drop below .90. From these results, it was felt that the investigator's judgements reflected a sufficiently high degree of stability. These raw scores were transformed into percentages for the quantitative analyses which follow.

Quantitative Analyses and Findings

As was done for both the ORIT and SRIT, the data generated by the DQIT were analyzed in terms of both the two types of cognitive synthesis, and the two levels of reading proficiency. These analyses and related findings are detailed in this section. First the cognitive synthesis analyses will be presented. This will be followed by the proficiency analyses.

Cognitive Synthesis. Based on the transformed percentage data generated by the DQIT, means and standard deviations were calculated. See Table 6.16. These analyses indicated less variability across the synthesis groups. This was probably related to the more structured nature of the task.

In an attempt to ascertain whether the observed differences were significantly related to successive and simultaneous synthesis, the data were submitted to a 2X2 analysis of variance where the main effects were successive and simultaneous synthesis. The results of these analyses for the forward-looking and backward-looking inferences has been summarized in Table 6.15. From these analyses it was revealed that for the forward-looking inferences, there was no significant main effect due to successive synthesis ($F(1,36)=.032;p=.86$). No significant interaction effect ($F(1,36)=.104;p=.75$) was also indicated. However, a significant main effect due to simultaneous synthesis ($F(1,36)=5.10;p=.03$) was revealed. When the means were examined, it was found that the high simultaneous ($\overline{X}=67$) were significantly higher than the low simultaneous ($\overline{X}=54$).

For the backward-looking inferences, the analysis revealed a significant main effect due to successive synthesis ($F(1,36)=4.423,p=.05$). No significance was indicated for simultaneous synthesis ($F(1,36)=2.186;$ $p=.15$). When the means for the two levels of successive synthesis were inspected, it was found that the low successive subjects ($\overline{X}=64$) were

Table 6.16 PERFORMANCE ON DQIT ON COGNITIVE SYNTHESIS GROUPS: MEANS AND STANDARD DEVIATIONS

Grp.[1]	FLI[2] $\overline{X}$ (s.d.)	BLI[3] $\overline{X}$ (s.d.)	Response[4] $\overline{X}$ (s.d.)	Support[5] $\overline{X}$ (s.d.)	Linkage[6] $\overline{C}$ (s.d.)
HH	68.4(15.02)	59.8(13.99)	89.0(15.95)	60.5(13.43)	55.5(14.99)
HL	54.0(13.76)	54.7(15.08)	85.0(10.80)	45.5(15.46)	41.5(14.92)
LH	65.6(20.67)	62.8(14.12)	95.0(9.72)	55.5(17.87)	56.5(20.69)
LL	54.8(20.05)	66.8(17.28)	89.0(13.70)	53.5(18.57)	51.0(17.45)

[1] HH=High Successive-High Simultaneous; HL-High Successive-Low Simultaneous; LH=Low Successive-High Simultaneous; LL=Low Successive -Low Simultaneous

[2] FLI=Forward-Looking Inferences

[3] BLI=Backward-Looking Inferences

[4] Response=Initial Responses on DQIT

[5] Supported=Stated Textual Support

[6] Linkage=verbalized linkage between response and support

Table 6.17 ANALYSIS OF VARIANCE SUMMARY TABLES: SUCCESSIVE (A) X SIMULTANEOUS (B) SYNTHESIS FOR FORWARD AND BACKWARD-LOOKING INFERENCE

1. Variable: Forward-Looking Inferences

Source	S.S.	df	M.S.	F-ratio	Prob.
A	10.00	1	10.00	.032	.86
B	1,587.50	1	1,587.50	5.103	.03 *
AB	32.37	1	32.37	.104	.75
SE	11,198.4	36	311.07		

2. Variable: Backward-Looking Inferences

Source	S.S.	df	M.S.	F-ratio	Prob
A	1,020.06	1	1,020.06	4.423	.05 *
B	96.125	1	96.125	.417	.52
AB	504.063	1	504.063	2.186	.15
SE	8,301.31	36	230.59		

* significance ≤ .05

significantly higher than the high successive subjects ($\overline{X}$-54) on the backward-looking inferences.

The same procedures were used to ascertain whether the two types of synthesis were significantly related to the variables of response, stated textual support, and verbalized linkage. For all three variables there were no significant interaction effects, nor were there any significant main effects due to successive synthesis or simultaneous synthesis. The analysis of variance for these variables has been summarized in Table 6.18.

Reading Proficiency Levels. The data generated by the DQIT were analyzed also in terms of the two levels of reading proficiency--the Very Proficient and the Less Proficient. Means and Standard Deviations were calculated for each of these groups, and the results were submitted to independent t-tests. See Table 6.19. For all comparisons, significant differences were indicated. Inspection of the means revealed that in all instances the Very Proficient were significantly superior to the Less Proficient Readers.

Discussion. In this section the findings based on the analyses of the DQIT will be discussed in light of the background literature review in Chapter 2. First, the findings will be related to previous work in cognitive synthesis and reading. This will be followed by a discussion of proficiency levels, and finally the findings will be related to the psycholinguistic - information processing literature.

It has been previously noted that Kirby and Das (in press) have reported that High-Successive-High Simultaneous subjects were superior in reading achievement to Low Successive-Low Simultaneous subjects, and that there was no significant difference between the

Table 6.18 ANALYSIS OF VARIANCE SUMMARY TABLES: SUCCESSIVE (A) X SIMULTANEOUS (B) SYNTHESIS FOR RESPONSE, SUPPORT AND LINKAGE VARIABLES

1. Variable: Response Acceptability

Source	S.S.	df	M.S.	F-Ratio	Prob.
A	250.0	1	250.0	1.53	.22
B	250.0	1	250.0	1.53	.22
AB	10.0	1	10.0	.06	.81
SE	5,880.0	36	163.3		

2. Variable: Stated Textual Support

Source	S.S.	df	M.S.	F-Ratio	Prob.
A	306.25	1	306.25	.113	.74
B	765.63	1	765.63	2.827	.10
AB	455.63	1	455.63	1.682	.20
SE	9,747.50	36	270.76		

3. Variable: Verbalized Linkage Between Response and Support

Source	S.S.	df	M.S.	F-Ratio	Prob.
A	275.63	1	275.63	.934	.34
B	950.63	1	950.63	3.223	.08
AB	180.63	1	180.63	.612	.44
SE	10,617.5	36	294.93		

?

Table 6.19 t-TESTS: VERY PROFICIENT AND LESS PROFICIENT READERS ON DQIT

	Very Proficient		Less Proficient				
	$\bar{X}$	(s.d.)	$\bar{X}$	(s.d.)	t	df	Prob.
FLI	72.4	(11.67)	49	(15.83)	5.319	38	.000 *
BLI	64.7	(14.35)	54.8	(16.26)	2.040	38	.048 *
Response	93.5	(12.26)	85.5	(12.34)	2.056	38	.046 *
Support	62.8	(12.51)	44.5	(15.72)	4.063	38	.000 *
Linkage	60.5	(13.17)	41.8	(16.57)	3.962	38	.000 *

FLI = Forward-Looking Inference
BLI = Backward-Looking Inference

* significance ≤ .05

achievement levels of the High Successive-Low Simultaneous and the Low Successive-High Simultaneous groups. Both attained moderate levels of achievement. The analyses of the forward-looking inferences on the DQIT supported that the High - High subjects were superior to the Low-Low subjects. However, the significant interrelationship between cognitive synthesis groups and levels of reading proficiency in the present study altered the findings for the two groups with mixed abilities in cognitive synthesis. The present analysis indicated that the Low Successive-High Simultaneous group was superior to the High-Successive-Low Simultaneous group. The present study revealed a significant relationship between proficiency in simultaneous synthesis and proficiency in forward-looking inferences in a question structured situation. This finding is in accord with Latham's earlier work which indicated high simultaneous subjects to be more proficient than low simultaneous. Successive synthesis was not significantly related to forward-looking inferences on the DQIT.

For the backward-looking inference on the DQIT, the analyses revealed that the performance levels of the four cognitive synthesis groups were significantly different from those reported by Kirby and Das. For this type of inference, in the structured question situation, no significant main effect due to simultaneous synthesis was found, but a significant effect due to successive synthesis was indicated. An examination of the means revealed that the low successive subjects were superior to the high successive subjects. This finding gives added support to Latham's (1973) suggestion that subjects who were ranked as successive synthesizers did less well on his chunking tasks. It would appear from the present analyses that a subject who predominantly used the successive mode of synthesis had difficulty with backward-looking inferences which require linking new information back to previously supplied information in order to answer the question. These findings give further support to the position that forward and backward-looking inferences are different in nature, and make different demands on the abilities of the reader. This position is in keeping with Leong's (1974) suggestion that the type of synthesis used by the reader is determined in part by the nature of the task.

When the DQIT data were analyzed in terms of proficiency in reading, it was found that the performance of the Very Proficient was significantly superior to that of the Less Proficient for both backward and forward-looking inferences. This would seem to indicate that reading proficiency is determined by factors other than just synthesis. It is hypothesized that the individual's ability to plan and direct his thinking and decision making within the constraints of the text is a crucial factor. This ability has been identified by Luria (1966b) as an important aspect of success in reading, and he has associated this ability with the frontal lobes of the cerebrum. This point will be discussed in greater detail in Chapter 7.

The significant difference between proficiency levels is in keeping with findings reported by Swain (1953) with college students, Piekarz (1954) with grade six students, and Jenkinson (1957) with high school students. The analyses of the subjects' answers to the inference questions in terms of acceptability of response, stated textual support, and verbalized linking between the response and the textual support revealed the Very Proficient were significantly higher in their performances on these variables than the Less Proficient. This supports the work of Piekarz (1954) and Jenkinson (1957) who reported that the Very Proficient subjects made greater and more accurate use of textual information.

Paris and Upton (1974) reported that the type of inference was a factor that influenced the level of children's performances on inference questions. They examined two types of inferences which they identified as lexical and contextual. Their study revealed that the contextual were more difficult for students in grade four. In the present study the contextual inferences were categorized further into forward-looking or backward-looking. The analyses of the findings indicated that Very Proficient Readers were superior to the Less Proficient on both the forward-looking and the backward looking inferences. When the two proficiency levels were combined, no significant difference was revealed between the forward-looking and backward-looking inferences on the DQIT.

SUMMARY

The analyses and findings of the three reading-related tasks which required the subjects to generate inferences have been reported in this chapter. The three tasks were: (1) the Oral-Reading Inference Task (ORIT), (2) the Story-Recall Inference Task (SRIT), and (3) the Directional-Question Inference Task (DQIT). The first two tasks were self-structured in that the subject was free to infer when and to the degree he desired. The last task was structured by ten questions to which each subject responded. In the first two tasks both quantity and quality were analyzed. In the last task the quantity was held constant, so only the quality was analyzed.

When the reading related tasks were analyzed in terms of proficiency in the two types of cognitive synthesis (successive and simultaneous), the following findings were revealed:

1. There were no significant differences due to cognitive synthesis for the quantity of forward-looking, or backward-looking inferences generatedby the subjects on ORIT or SRIT.
2. There were no significant differences due to cognitive synthesis for the categories of supported and non-supported inferences generated on SRIT.
3. There was a significant difference due to simultaneous synthesis for the generation of acceptable inferences on ORIT. The high simultaneous groups generated more acceptable inferences than the low simultaneous groups.
4. There was a significant difference due to simultaneous synthesis for the number of story units recalled. The high simultaneous groups recalled a significantly greater number of units.
5. When comparisions were made in terms of acceptability of forward and backward-looking inferences was made within the cognitive synthesis groups, it was found that the high simultaneous groups generated significantly more acceptable forward-looking inferences than the low simultaneous groups on the ORIT, but not on the SRIT.
6. For the backward-looking inferences, all four cognitive synthesis groups generated significantly more acceptable than non-acceptable inferences on both the ORIT and SRIT.
7. There was a significant difference due to simultaneous

synthesis for forward-looking inferences on the DQIT. The high simultaneous groups' performances were superior to the low simultaneous.

8. There was a significant difference due to successive synthesis for backward-looking inferences on the DQIT. The low successive groups performances on these inferences were superior to the high successive groups.

9. There were no significant differences due to the two kinds of synthesis for the acceptability of the responses, the stated textual support, and the verbalized linkage on the DQIT.

The following findings have been based on the analyses of the data generated by the reading - related tasks in terms of the two levels of reading proficiency (very proficient and less proficient).

10. There were no significant differences due to the two levels of proficiency for the quantity of forward-looking, or backward-looking inferences on either the ORIT or the SRIT.

11. There was a significant difference due to the level of reading proficiency for the acceptability of the inferences generated on the ORIT, but not the SRIT. In the former instance the Very Proficient generated significantly more supported inferences.

12. There was a significant difference due to the two levels of reading proficiency for the number of story units included in the SRIT protocols. The Very Proficient Readers recalled a greater number of story units.

13. There was a significant difference due to the two levels of proficiency for the number of forward-looking, and backward-

looking inferences generated. The Very Proficient generated more forward-looking than backward-looking inferences on the ORIT, but not on the SRIT.

14. There was a significant difference due to the two levels of reading proficiency for supported/non-supported inferences. The Very Proficient Readers generated more supported than non-supported for both forward and backward-looking inferences on both ORIT and SRIT. The Less Proficient Readers only generated more supported than non-supported backward-looking inferences on both the ORIT and the SRIT.
15. There was a significant difference due to the two levels of reading proficiency for the two kinds of inferences on the DQIT. The Very Proficient generated higher performance scores than the Less Proficient Readers for both forward-looking and backward-looking inferences.
16. There was a significant difference due to the two levels of reading proficiency for the acceptability of responses, stated textual support, and verbalized linking between the response and support. In each of these categories the Very Proficient were superior to the Less Proficient Readers.

These findings have been discussed in light of the reviewed literature in Chapter 2. Further theoretical implications are discussed in Chapter 7.

CHAPTER 7

DISCUSSION OF FINDINGS

In Chapters 5 and 6, brief discussions were provided which linked the specific findings with previous research. The purpose of the present chapter is twofold: first, it will place the major findings of Chapters 5 and 6 within the theoretical framework provided in Chapter 2; second, based on the findings of the present study, modifications to the Das, and Ruddell theoretical models will be presented. At this point in research into inference in reading comprehension, these modifications must be viewed as tentative. However, that does not mean to indicate that the recommended modifications are tenuous. Illustrative examples from the transcribed protocols of the subjects will be provided, where appropriate, to support the investigator's theoretical position.

Three general areas for which the finding may have theoretical import will be discussed. These are: (1) the concept of inference in reading, (2) the sources of textual information available to the reader for the generation of inferences, and (3) cognitive processes involved in the generation of inference, in particular successive and simultaneous synthesis. A brief summary concludes the chapter.

THE CONCEPT OF INFERENCE IN READING

One of the major problems which has plagued this investigation from its conception, through its execution, and reporting has been the definition of inference. Reference to teachers' manuals for instructional reading materials, and the theoretical literature on reading comprehension provided rather vague descriptions of inference as "reading between the lines," (Thorn and Richmond, 1972) or "going beyond the information given" (Bartlett, 1951), or skill definitions of inferences in which specific inferences were listed, such as "inferred main idea, sequence, or cause effect". (e.g. Smith and Barrett, 1974) Such definitions provided very little direction for the exploration of the cognitive processes related to inference.

The definition provided in this study reflects the investigator's attempts to express the concept of inference in terms of what the reader does. Consequently, the definition has been limited to the reading situation, and in particular, to the reading of continuous narrative written discourse. It is not offered as the definition of inference, but rather as an initial attempt to focus on the cognitive processes related to, as well as the product of, inferencing. This definition was given first in chapter 1, and has been restated below:

> Inference - cognitively generated information based on explicit linguistic and non-linguistic information provided in the context of continuous written discourse, and which was previously unstated.

The major points made in this definition have been identified below. Numerals have been used to aid identification. An inference is (1) information (2) previously unstated explicitly by the author (3) which is generated by the reader (4) on the basis of (5) and within the constraints of (6) the author's textually presented information. Undoubtedly it could be argued that many of these points are assumed in the more general definitions of inference; however, this appears to be the first time that all six of these points have been stated explicitly in one definition. Having carried out the present investigation on the basis of the above discussed definition, this investigator has become increasingly aware of the conceptual complexity, and the integrative function of inference in reading comprehension. These two aspects of the nature of inference will now be discussed.

The Complexity of Inference

This investigation has indicated the complexity of the processes involved in inference generation in reading comprehension. Clearly an inference cannot be generated successfully without the prerequisite skills of oral and written language which Ruddell (1974) has included in the first component of his model. Without adequate proficiency in the processes necessary for the recognition and identification of the words, and sufficient experience to provide adequate meaning for the words, the reader will have difficulty making acceptable inferences. This is illustrated in the following excerpt from the ORIT protocol of a Less Proficient reader.

> Subject #7 Scotty was the Brown's pet terror. Like he's a monster. Although he couldn't talk, he let everyone know what he wanted...by drawing pictures or writing things...If he wanted outside...

The miscue of "terror" for "terrier" resulted in two unsupported inferences. Although the influence of the first component of Ruddells' model is recognized for inference, it was not the focus of the present study. Adequate ability in the aspects of oral and written language was assumed on the basis of the high average to superior standings of the subjects on the vocabulary subtest of the standardized reading test. While miscues were noted in other protocols, this is the only example which reflected in the inferences generated.

However, the complexity of the concept of inference has been indicated for the aspects of interpretation (Ruddell's third component), as well. Previous research (Paris and Upton, 1974) has shown that the concept of inference can be viewed from at least two levels - lexical and contextual. The present investigation has revealed significant differences within the contextual level.

This study of inference has been limited to the two types of contextual inference identified by Schank (1975) as forward-looking and backward-looking. The findings of this investigation have indicated that the observed maturing readers were generally more proficient in generating acceptable backward-looking inferences than they were for forward-looking inferences in the self-structured reading situations of ORIT. On SRIT both Very Proficient and Less Proficient Readers generated more supported than non-supported inferences of both types. These findings have been interpreted as support for the psychological reality of Schank's theoretical distinction between forward and backward-looking inferences.

In addition, the study has revealed that inference proficiency varies with the task. On the Oral Reading Inference Task (ORIT) there was no significant difference between the Very Proficient and Less Proficient Readers in terms of the quantity of forward and backward-looking inferences generated. However, the Very Proficient Readers were significantly superior to the Less Proficient in the generation of textually supported inferences on ORIT. On the Story Recall Inference Task (SRIT), there was no significant difference between the Very Proficient and Less Proficient Readers in terms of either quantity or quality of the two types of inference. When within-group analyses were made on this data, it was revealed that both levels of reading proficiency generated more supported than non-supported inferences.

On the question structured task (Directional Question Inference

Task), the Very Proficient were significantly superior to the Less Proficient on both forward and backward-looking inferences. Moreover, the analyses of the data produced on the task indicated that the Very Proficient generated more textually supported inferential responses, provided more textual support for their inferential responses, and were more proficient in verbally linking the textual support with the inferential response than the Less Proficient Readers. The analyses of this data would seem to indicate that the question asked may be a factor. From the findings of the three tasks, it would appear that the nature of the task is an important variable related to proficiency in textually supported inference generation.

The foregoing discussion has attempted to indicate the complexity of the concept of inference at the interpretive level. Successful inference generation appears related not only to general reading proficiency, but also to the type of inference. Further, proficiency in inference generation appears to be task sensitive.

Inference as an Integrative Comprehension Strategy

Schank (1975) has stressed the importance of inference for both understanding and recall. He has suggested that forward-looking and backward-looking inferences are used to enhance understanding and facilitate recall. Paris (1975) has referred to inference as an integrative aspect of comprehension. Comprehension of written language appears to require at least two different integrative cognitive processes. One integrative function of inference has been identified as elaboration (Paris 1975). This elaborative function of inference appears to be what Schank refers to as forward-looking inferences. These inferences tied together stated information within higher level cognitive structures. On the other hand, Schank (1975) states that the backward-looking inference fills in gaps in stated information to facilitate understanding of the text. This inferred information provides a link between the given units of information so that they are meaningful. Thus, it would appear that the reader may integrate the ideas generated during his reading of the written text by elaboration and/or linking. The following example taken from *ORIT* and *SRIT* illustrates a reader using both strategies.

Subject #34 (*ORIT* protocol) ...The days came when leaves on the trees changed colours {[It must be fall]} Then the sounds of shots echoed through the woods on Miss Bella's farm. {[There must be hunters somewhere]} She shuddered with each report. Which one would be lost today?...

The first inference, "It must be fall" is a forward-looking inference which integrates the information of "leaves", "trees" and "changing colour" into higner level cognitive structure "fall". However, the second inference, "There must be hunters somewhere", provides causative information to link "the sounds of shots" to the previous information indicating the season and the presence of animals on the farm.

It is interesting to note that these inferences appear in this subject's story recall. This has been interpreted as support for the theoretical position posited by Schank (1975) and previously described.

Subject #34 (*SRIT* protocol) ...and whenever people get sick she goes to their house, {(like a neighbour's home)} {(And then it came fall)} and {[there were hunters going around]},and {[Miss Bella was scared]} that the animals she took care of would get shot...

Both the inferences referred to in *ORIT* appear in *SRIT*. In addition, the information that she "shuddered with each shot" is replaced by the backward-looking inference which provides Miss Bella's feeling of being "scared" as the reason for her "shudder". As this example illustrates, maturing fourth grade readers utilize both forward and backward-looking inferences to integrate the textually provided information into a cognitive structure which is meaningful to them. By so doing they facilitate their understanding and enhance their recall of continuous narrative written discourse. In the present study the findings indicated that both Very Proficient Readers and Less Proficient Readers utilized inference in this way. Although both reading proficiency level subjects used the strategies, they did not do so with equal proficiency. Some of the differences have been mentioned earlier in this section. Further discussion of the differences will be provided in the third section of this chapter.

In this section, the discussion of the findings of the present study has focused on the nature of inference. In particular, consideration has been given to the complexity, and the integrative aspect of inference in reading continuous narrative written discourse. In the next section, the discussion will focus on the sources of textual information available to the reader to support the generation of both forward and backward-looking inferences.

INFERENCE AND SOURCES OF TEXTUAL INFORMATION

A discussion of the textual information used by the subjects in the generation of backward and forward-looking inferences will be presented in this section. At the outset it must be recognized that the "aspects of meaning" component of the Ruddell model of communication, while recognized as an important factor in the processes of inference, was not the major focus of this investigation. Therefore, the design of the study did not control the availability of the various sources of textual information. As a result conclusive findings are not available. However, the analyses of the subjects' protocols revealed support for the position that the reader makes use of a variety of kinds of information when reading. Therefore, the following discussion will be descriptive in nature and will attempt to show the potential value of the Baker-Prideau-Derwing "Information Structure" theory of meaning for exploring the kinds of textual information used by different types of readers. As pointed out in the introduction to this section, the stimulus stories were not designed to investigate the specific embedded aspects of I_d, I_r, I_s, and I_c as defined by Baker (1976) and Prideaux (1975). Although instances were identified in the subjects' responses which indicated the use of I_d, I_r, and I_s, no specific mention was made of these kinds of information. Thus, more global classifications of "word", "sentence", and "beyond sentence" were used to identify the information used to generate inferences.

The findings from the analyses of the ORIT data revealed that both Very Proficient and Less Proficient Readers were utilizing primarily sentence and beyond sentence level information to generate their inferences. This undoubtedly reflects the embedded nature of continuous discourse comprehension, and may explain why I_r information was not observed in the responses. Relational information (I_r) focuses on the parts of sentences and their relationships. If, as the present findings seem to indicate, readers, when reading continuous discourse, function at and beyond the sentence level of information, then their focus is not as much within the sentences where the relational information is found.

As mentioned previously, examples of the use of lexical information, sentential information, and contextual information were identified. In the remaining part of the section examples will be provided and discussed.

Word Level Information (I_d)

The findings based on the qualitative analyses at word level indicated that it was the kind of information least used to generate inferences (9% - 12%). Some of the inferences generated at the word level indicated greater use of experiential background than textual information. For instance, the word "cottage" in the first sentence of the story about Miss Bella triggered inferences which included generated information about beaches. Illustrative examples are provided below:

Subject #11 Miss Bella lived by herself in a little white cottage {[If she's in a cottage its like a cabin at the end of a beach]}...

Subject #22 Miss Bella lived by herslef in a little white cottage. {[She's probably living somewhere near the beach in a little white cottage]}...

Often processing at a word level resulted in what was identified as a translative statement. The following are provided as illustrative examples.

Subject #20 ...The floors and the walls were all ablaze {(When it says all ablaze it means completely on fire)}.

Subject #24 ...All I need now is a gun and some shells -- {(some bullets) } -- Then I'll be ready to have some fun...

Subject #8 ...He showed his dislike for the neighbours cat by barking furiously at it whenever it happened to appear. { (So if he showed his dislike then he didn't like cats; so he barks at 'em) } ...

The limited use of word level information would seem to suggest that discourse comprehension focuses the reader beyond word meanings on ideational relationships.

Sentence Level Information (Ir and Is)

In Baker's (1976) "information structure" theory of meaning sentence level information is of two kinds. These are relational (information represented by the relationships of the components within the sentence) and sentential (information indicated by the kind of sentence). As indicated above, the present study was not designed to control these two types of information. As a result no instance of the use of relational information was reported. However, one illustrative instance of the use of sentential information was produced in the story about Miss Bella.

In the third paragraph there is a series of interogative sentences which a number of subjects appear to have used as a basis for generating backward-looking inferences. These inferences explained what Miss Bella was doing, and/or how she felt. The following examples illustrate this instance of the use of sentential information. Having read the three interogative sentences, these subjects made the following inferences.

Subject #18	...Shes wondering.
Subject #28	...She's wondering, thinking.
Subject #5	...Like she wondered what would be killed today.
Subject #38	...She was worried about her little friends.

The first two examples were generated by Less Proficient Readers. The latter two were produced by Very Proficient Readers. The Very Proficient Readers related their inferred information more explicitly to the textual information. Sixty percent of the Very Proficient Readers who read "Miss Bella's Plan" used this sentential information as the basis of similar inferences. Only thirty percent of the Less Proficient used this information. It would appear that the Very Proficient Readers may be more aware of, and efficient in the use of sentential information when generating inferences.

When comparisions were made across the two inference types for the use of sentential information, it was found that both the Very Proficient and the Less Proficient Readers generated more forward-looking inferences (60% and 62%) than backward-looking inferences (48% and 40%) from sentence level information. This is interpreted as further support for Schank's distinction between forward-looking and backward-looking inferences. The latter appear to be more context bound. This will be discussed further in the following section.

Beyond-Sentence Level Information

Contextual information(I_c) according to Baker (1976) and Prideaux (1975) refers to contextual or discourse factors which have been previously established and now govern the interpretation of particular textual information currently under consideration. A comparison of the use of sentence level and beyond sentence level for all the subjects revealed a greater use of sentence level information (54%) to generate inferences than beyond sentence level information (35%). The maturing readers studied in this investigation appear to be moving toward use of contextual information, but still depend heavily on the sentence as a source of information for inference generation.

When comparisions were made between forward and backward-looking inferences generated from information provided in more than a single sentence, it was found that more backward than forward-looking inferences were generated by both the Very Proficient (45% to 28%) and the Less Proficient (47% to 28%). This finding is interpreted as further support for distinguishing between forward and backward-looking inferences.

Summary

The findings discussed in this section have provided support for using the Baker (1976) Prideaux (1975) "Information Structure" of meaning to explore the kinds of information readers use to generate inferences. The distinction between sentence level and context level information has been used to distinguish the nature of forward and backward-looking inferences. Recognition of sentential and contextual information in the Ruddell model would provide a more comprehensive view of the "Aspects of meaning" that maturing readers utilize when reading continuous narrative written discourse. An elaborated "Aspects of Meaning" component is shown in Figure 7.1. Although further research is needed to indicate the significance of the findings described in this investigation, it would appear that maturing readers use a variety of sources of information to generate inferences. These include lexical information, sentential information, and contextual information.

This section has considered the "Aspects of meaning" component of Ruddell's model in light of the findings of the present study. The next section is devoted to a discussion of the "Interpretation" component of Ruddell's model.

INFERENCE AND COGNITIVE PROCESSES

As stated in the first chapter of this report, one of the major purposes of this exploratory investigation was to attempt to relate the

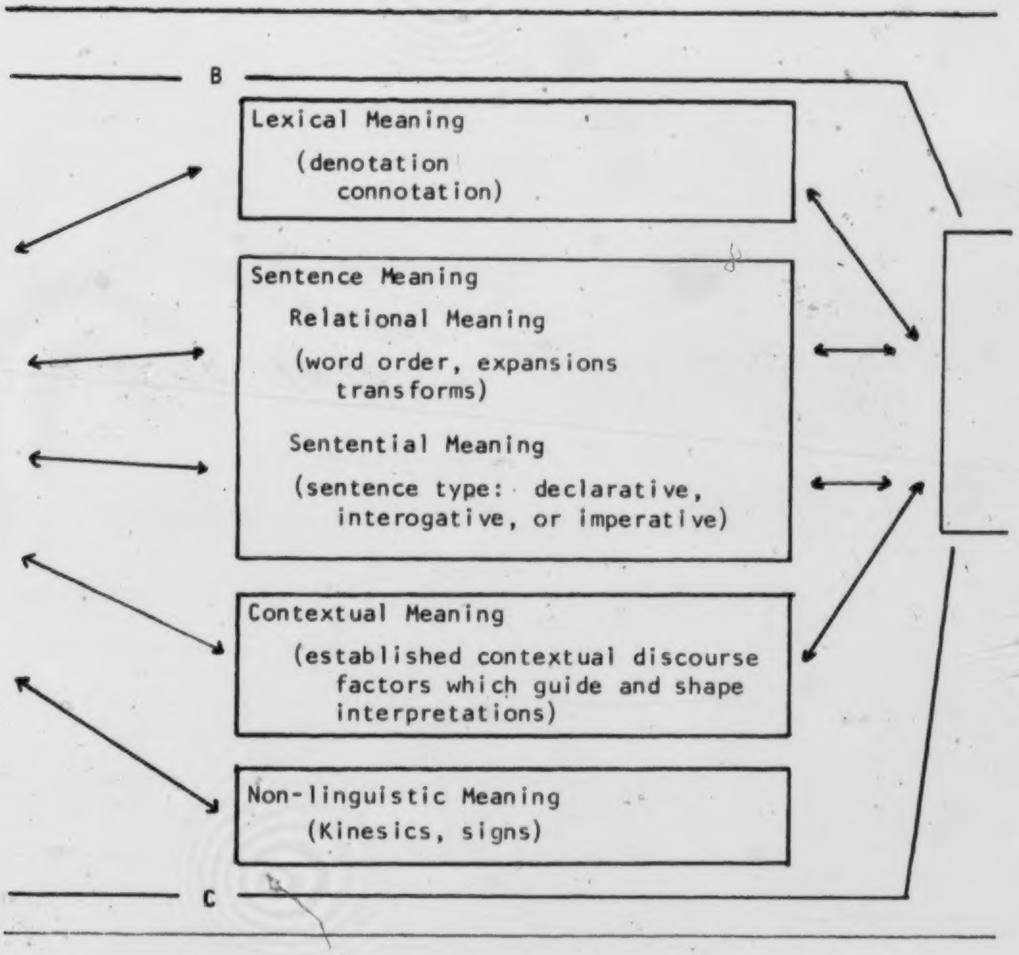

B
Lexical Meaning
(denotation
connotation)
Sentence Meaning
Relational Meaning
(word order, expansions
transforms)
Sentential Meaning
(sentence type: declarative,
interogative, or imperative)
Contextual Meaning
(established contextual discourse
factors which guide and shape
interpretations)
Non-linguistic Meaning
(Kinesics, signs)
C

Figure 7.1 AN ELABORATED "ASPECTS OF MEANING" COMPONENT.

generation of forward-looking and backward-looking inferences to the cognitive processing of the selected fourth grade subjects observed. In particular, this study focused on the two types of cognitive synthesis identified by Luria (1966a) as successive and simultaneous synthesis. Previous research (Latham, 1973; Leong, 1974; Kirby and Das, 1977) has related these two types of cognitive synthesis to reading proficiency in general. This study has attempted to relate the two types of synthesis specifically to inference in reading comprehension. In this section, the discussion will focus first on the findings of Chapter 5. Then the findings of Chapter 6 will be discussed within the framework of the "Interpretation" component of Ruddell's (1974) model. Theoretical implications for the "Model of Information Integration" proposed by Das, Kirby and Jarman (1975) will be presented also.

Reading Proficiency and Cognitive Synthesis

It was reported in Chapter 5 that the subjects' performance scores on the test of successive synthesis (Visual Short Term Memory) were not significantly related to their proficiency levels in reading; however, a significant relationship was found between the subjects' performance scores on simultaneous synthesis (Memory for Design Test) and reading proficiency. The subjects who ranked high on the test of simultaneous synthesis were predominantly Very Proficient Readers. This finding varies from the earlier results of the Kirby and Das (1977) study which reported significant relationships between both types of synthesis and reading proficiency.

In part, the difference may be accounted for by the nature of the subjects studied in the present investigation. Only two very select sub-groups of grade four readers were observed: the Very Proficient (above the 85 percentile in both reading vocabulary, and comprehension) and the Less Proficient (70 percentile and above in vocabulary development, but 55 percentile or below in comprehension). The difference in reading comprehension between the two levels of reading proficiency is decidedly marked. Kirby and Das observed all levels of proficiency for 104 grade 4 boys in regular urban schools. The sample size of the present investigation (N=40) may also be a contributing factor.

However, the fact remains that the present findings indicated a significant relationship between the scores on the simultaneous synthesis test and level of reading proficiency, but no significant relationship was revealed between the scores on the successive synthesis text and reading proficiency. The following explanation is an attempt to expl the findings of this investigation within the theory of Sechenov and Luria.

In the tradition of Soviet psychology, both Sechenov and Luria have stressed the socio-historical development of the higher mental functions in human beings. Interpreting the present findings within a developmental framework, it would appear that the Very Proficient and Less Proficient Readers were at similar levels of development as far as their abilities on the test of successive synthesis are concerned. But they appear to be at different developmental levels on simultaneous synthesis according to their test scores. To further explore this interpretation, one must consider the sensory bases of the two types of synthesis.

Sechenov (1878 reprinted 1973) related successive synthesis to motor and auditory development, while simultaneous synthesis was linked with visual and kinetic sensory input. Luria (1966a) has re-affirmed that simultaneous synthesis reflects visual and tactile sensory input. To link these sensory bases to the child's mental development, let us consider Piaget's stages of development, since one of the assumptions of this study is that all subjects were in the concrete operational stage of development.

According to Piaget's schema of development, the children observed in the present investigation have passed through two prior stages. These are the sensori-motor and pre-operational stages. Luria (1966a) has pointed out that a child's mental development "is based on functional systems" (p.59) and he has suggested that the focus of these functional systems as well as their characteristics vary from one developmental stage to another. During the sensori-motor stage the emphasis seems to be on motor development, which would seem to focus more on the aspect of successive synthesis. This is not to suggest the simultaneous synthesis is not present. Luria suggests that both are present, but simultaneous synthesis is at more rudimentary stages of development. With the addition of language, simultaneous synthesis comes more to the fore, but successive synthesis remains very much in the focus of development during the preoperational stage. It is suggested that in the concrete operational stage, for the first time the major emphasis is placed on the development of abilities related to simultaneous synthesis. However, during this stage the development is at a concrete level. The task of reading is a more abstract form of mental activity that requires both successive and simultaneous synthesis. It may be that the successive aspects of reading are more related to the "Aspects of oral and written language" component of

Ruddell's model. From the findings of this study, it would appear that the Very Proficient Readers, who by definition in this study were more developed in reading ability, may be more advanced in their development at the concrete operational stage and therefore are more able to apply their concrete knowledge and related ability in simultaneous synthesis in the more abstract reading situation.

A factor which has not been considered to this point is the influence of the previous three years of formal school. It may be that the earlier years of school instruction capitalizes more on activities requiring successive synthesis (e.g. sequential activities such as phonic analysis, alphabet memorization, and rote counting) than simultaneous synthesis. Whether the similarity of the two levels of reading proficiency on the test of successive synthesis is related to its ontologically primitive nature, or to the nature of early formal school instruction, or combinations of the two is not clear. However, the scores on the test of simultaneous synthesis did discriminate between the Very Proficient and Less Proficient Readers. This relationship was expected based on Luria's (1966a, p.76) statement that "Synthesis of elements into whole simultaneous groups constitute a fundamental condition for the still more complex intellectual processess". Further, Luria (1966a, p.85) has identified reading as one way to measure simultaneous synthesis.

This part of the discussion has considered the relationships of cognitive synthesis and general reading proficiency as measured by a standardized reading achievement test. A developmental interpretation of the findings of this investigation has been suggested. The next part of the discussion will focus on the relationships indicated by the present findings between successive and simultaneous synthesis, and forward and backward-looking inferences.

Inference and Cognitive Synthesis

In the present study, each subject completed three reading-related inference tasks. These were (1) the Oral Reading Inference Task (ORIT), (2) the Story Recall Inference Task (SRIT), and (3) the Directional Question Inference Task (DQIT). The first two tasks were self structured with regard to inference. That is, each subject determined if he would generate any inferences; when, and the kind of inference also were determined by the reader. The DQIT was a question structured task with a predetermined number of questions for each type of inference. The analyses of ORIT and SRIT focused on both the number of inferences (quantity), and the textual supportability (quality) of those inferences. In DQIT only qualitative scores were generated. However, because of the more structured nature of this task, a more detailed analysis of the textual support for the inferential responses was possible.

The following discussion will consider first the findings based on the ORIT and SRIT analyses. This will be followed by an examination of the DQIT findings.

On Self-Structured Reading Tasks. There would appear to be no significant relationship between the two types of cognitive synthesis and the quantity of forward and backward-looking inferences generated on ORIT and SRIT. This interpretation has been based on the findings of the two-way analysis of variance which revealed no significant interaction effects, or main effects for the number of forward-looking inferences, and the number of backward-looking inferences generated on these two tasks. The initiation and execution of the inference processes would appear to be related to other cognitive processes.

When analyses were made of the number of textually supported inferential responses, the findings indicated no significant differences among the four cognitive synthesis groups for the number of supported inferences generated on SRIT; however, a significant main effect due to the simultaneous synthesis was revealed for the number of supported inferences generated on ORIT. The high simultaneous subjects generated significantly more supported inferences than did the low simultaneous subjects. Analyses within the four synthesis groups in terms of the number of supported inferences for each type of inference revealed that all four groups generated significantly more supported than non-supported backward-looking inferences, but only the high simultaneous groups (High Successive - High Simultaneous, and Low Successive - High Simultaneous) generated more supported than non-supported forward-looking inferences. The differences observed in the general support analyses appear to be related to the kind of inference. As discussed in an earlier section of this chapter this finding has been interpreted as support for Schank's theoretical distinction between forward-looking and backward-looking inferences.

When interpreting the cognitive synthesis findings for inference, it must be kept in mind that there was a significant relationship between simultaneous synthesis and reading proficiency. Analyses of the ORIT data revealed that the Very Proficient Readers generated significantly more supported than non-supported forward and backward-looking inferences. This seems to confirm the significant relationship between proficiency in reading and simultaneous synthesis.

On a Question-Structured Reading Task. The findings based on the analyses of the DQIT provide some clarification of the difference observed for the quality of inferences generated on ORIT. A significant relationship between high performance on the test of simultaneous synthesis and high performance scores on the forward-looking inferences was revealed by the analysis of the DQIT. As has been indicated in the previous discussion, analyses based on reading proficiency revealed that the Very Proficient were significantly higher on their forward-looking inference scores than the Less Proficient Readers. The confounding of simultaneous synthesis within reading proficiency is again indicated. However, Luria (1966a) has pointed out that simultaneous synthesis is a prerequisite to higher mental processes. Experts in the field of reading (Smith and Barrett, 1974; Ruddell and Bacon, 1972; Ruddell, 1974; Russell, 1970) have indicated that inference requires higher levels of thinking ability. Therefore, it is argued that inference proficiency in reading is indicative of efficient simultaneous synthesis which is viewed as a prerequisite for inference generation. It would appear that the "higher mental processes" enhance the reader's proficiency in generating acceptable forward-looking inferences. This will be discussed further in the next section.

For the scores on the backward-looking inference questions, a significant negative relationship was revealed for successive synthesis when the analysis of variance was computed. The subjects who ranked low on the test of successive synthesis attained significantly higher scores on the backward-looking inference questions than the subjects who ranked high on successive synthesis. A comparision based on reading proficiency levels, indicated that the Very Proficient Readers achieved significantly higher scores than did the Less Proficient Readers on the backward-looking inference questions. This negative relationship between successive synthesis and the generation of backward-looking inferences can be interpreted in light of previous research into reading and cognitive synthesis (Latham, 1973; Leong, 1974). In his study, Latham (1973) found that the subjects who ranked low on his test of simultaneous synthesis were less able to apply appropriate chunking (synthesizing) strategies when reading. He interpreted this as an indication that one of the causes of poor reading was the use of inappropriate synthesizing strategies. Leong (1974) stressed that differences in tasks had to be considered as well as differences in the human readers. Some tasks seem to require a greater use of simultaneous synthesis while others depend on successive synthesis. Within this framework in which appropriate integrative strategies are related to the task, and determined by the reader, the present findings would seem to indicate that successive synthesis may indeed be a less efficient integrative strategy considering the nature of the backward-looking inference task when reading continuous narrative discourse. A brief analysis of the backward-looking inference task is provided to further clarify this finding.

When faced with the task of understanding a continuous narrative written discourse, the reader attempts to create a meaningful cognitive structure based on the author's textually presented information. However, in any text, an author has represented certain pieces of information explicitly, but may also assume certain pieces of information which are not explicitly stated. The reader's task is two fold: (1) he must recognize first when the author has assumed that he, the reader, will supply information, and (2) the reader must be able to provide information which will "fillthe gap" created by the author's assumption. To fill this gap of assumed information, the reader must be able to survey contemporaneously his cognitive representation of previous textual information, and the "new" textual information. If this cannot be done, the reader will not be aware of the gap. This surveyability of information in the reader's cognitive representation is also crucial to ensuring that the inferential information (reader supplied) fits. According to Luria, successive synthesis does not allow this "surveyability". Thus, the reader who has a high tendency to use a successive synthesis strategy will encounter difficulty in both of the afore described aspects of backward-looking inference generation.

Earlier in this discussion of DQIT findings, it was reported that the Very Proficient Readers achieved significantly higher scores on the backward-looking inferences than the Less Proficient Readers. This finding has been interpreted as further support for the position that other cognitive processes are crucial in the generation of inferences. Based on observations of the DQIT analyses, and statistical tests of these analysis,it would appear that the psychological functions which Luria has related to the frontal lobes,namely, decision making, program development, implementation, and cessation may play very important roles in the generation of inferences. This will be discussed further in the next section.

Beyond Synthesis

Throughout the previous section, the observation was made on several occasions that cognitive factors other than synthesis appeared to be contibuting to proficiency in inference generation.

This point is demonstrated with even greater clarity by the findings of the qualitative analyses of the subjects' DQIT protocols.

The scoring procedures of the subjects' responses on DQIT have been detailed with illustrative examples in Chapter 6. Therefore these procedures will not be restated here; suffice it to say that three sub-scores were generated. These were: (1) acceptability of initial inferential response, (2) verbalized textual support for the inferential response, and (3) verbalized linking of the inferential response with textual support. Since actual quantitative scores were generated in each category, analysis of variance was used to explore the relationships between the two types of synthesis and the three aforementioned variables.

The findings of these analyses indicated no significant interaction effects, and no significant main effects due to either successive or simultaneous synthesis for each of the three sub-scores. However, when comparisions on these variables were made in terms of the two levels of reading proficiency, it was revealed that the Very Proficient Readers had generated significantly more acceptable inferential responses, provided more textual support for their responses, and verbalized the linking of the inferential responses with the textual support more efficiently. From these findings it would appear that cognitive factors, other than synthesis, differentiated between the Very Proficient and Less Proficient Readers on the question structured inference task.

In the previous section, it was suggested that the psychological functions which Luria (1966a, 1966b, 1970) has identified with the frontal lobes of the human brain appear to play a crucial role in inference generation. These functions include (Luria, 1970) the "programing, regulating, and verifying mental activity".

From his investigation of patients with lesions in the frontal lobes of the cerebrum, Luria (1966a, p.284) has concluded that successful reading is based on "preliminary investigation" of the text to identify "the basic system of connections" essential to meaning. When the DQIT were administered individually to the subjects, the stimulus story was in front of the subject. The investigator observed that the Very Proficient Readers referred to the text before responding to the questions. On the other hand, the Less Proficient Readers tended to respond immediately to the question without reference to the text. The analysis of the DQIT protocols revealed that the initial responses of the Very Proficient Readers included significantly more textual information to support the inferential response. The following example is illustrative of this point.

Subject #11 (very proficient female)

R: What kind of a person was Miss Bella?

S: She was a kind person. She couldn't stand to see animals killed or hunted, and she helped people that were sick or in trouble.

R: Why do you think that?

S: Because here in the story it tells how she fooled some people and actually pretended that she had taken up hunting to save her animal friends. And it also says that whenever sickness struck one of the homes of the neighbours Miss Bella was there to help. So she must have always helped anybody that was sick or needed help.

In contrast, the typical answer of the Less Proficient Reader provided only the inferential response. The probe question was required before any reference to textual information was made. There was also a tendency among some of the Less Proficient Readers to introduce irrelevant information. The following is an example.

Subject #29 (less proficient female)

R: What kind of a person was Miss Bella?

S: Well, she was a very kind person.

R: Why do you think so?

S: Well, she cared for everything. Yet she didn't want to harm anything.

R: Is there anything else?

S: No, I guess not.

R: Is there anything in the story that makes you think she was kind?

S: Here. (reads) She noticed that few hunters came to her farm. Still each day she would take the gun and walk across the field to the woods. There she would fire two or three blaskets into the bank of the little creek. If she ever saw a visiting hunter she would squint through her glasses at him. (Stops and looks at investigator).

R: Okay. Why does that make you think she is kind?

S: Well, if she squints she doesn't really want them there.

As well as introducing irrelevant information, some of the responses of the Less Proficient Readers reflected inaccurate connections based on the subject's initial investigation during the oral reading of the story. The following two examples illustrate this point. Both reflect ideational miscues related to the word "struck". These responses were both made for the question 'What kind of a person was Miss Bella?'

Subject #28 (less proficient female)

S: A helpful person.

R: Why do you think that?

S: Cause if you were struck, she was always there to help them...

Subject #21 (less proficient male)

S: Uh a helpful person...

R: Why do you think that?

S: Cause she didn't want hunters around. And she put up signs. And whenever a strike of lightning hit somebody's house she'd always be helping them. Cause she didn't want anybody to get hurt.

When asked to read the part of the story that made him think lightning struck the house, he discovered it was "sickness" rather than "lightning" that struck. Even then he maintained his original thinking. He completed his response with "Well, that's what I thought it meant. I though it was a struck of lightning."

Schank (1975, p.240) has indicated that a crucial aspect of successful inferencing is knowing how to use context to direct inferencing. From these responses, and numerous instances where Less Proficient Readers responded that there was nothing in the story to make them think what they did, it would appear that the Less Proficient Readers are less able to use context to direct their inferencing.

A second point which Schank (1975, p.240) maintains is crucial to successful inferencing is knowing "when to stop making inferences." The Very Proficient Readers tended to make their inferential responses, provide the support of textual information and stop. Examples of subjects going on inferencing were also found in the Less Proficient Readers' protocols. The following provide examples of subjects not knowing when to stop the generation of the inference.

Subject #20 (less proficient male)

R: How did Father feel about Scotty's barking at the end of the story?

S: Well he was glad he was barking to wake up the family because there was the fire.

R: Why do you think that?

S: Well, umm, he don't have save their whole, like he can to himself. Cause animals are sometimes afraid of fire, and the sorta wont, or whatever -- like horses, they sorta get nervous, and if there's somebody on them, they might buck them off, or something.

Subject #10 (less proficient male)

R: Why were there three fire engines pulling up in front of the house as the children stumbled unto the lawn?

S: Three fire engines--probably, that was probably a real big fire. And they needed three fire engines, too, you know. Anyway maybe there wasn't any fire hydrant, and one was just for a ladder, and the other two were just for carrying water. And then and then they had all the hoses there.

R: Why do you think that?

S: Well, I guess to put the fire out, you know. And, well that's why they invented the fire engine you know. Because, you know, in the old days, they had quite a few fires. And there was just little pails of water. And it was so much work. And then they invented the fire engines, and they hooked up the hoses, and just moved their arms around a little bit, and the fire was out. So it was easier to put out the fire instead of using pails you know. There might be a tank of water over these, sure, but they always had to run back and forth, back and forth, putting out the fires, you know--each pail of water --and they had to run you know. And you might be running along, and then you fall down, and all the water goes out, and you have to run back again, and fall down again.

R: Is there anything in the story that makes you think that?

S: No, I guess not.

It would appear that once this subject started generating information from his background knowledge, he paid no attention to textual constraints, and did not seem to know when to stop. This subject's responses to all ten questions reflected this type of answer. While other Less Proficient Readers were not as prolific in their generation of information, their responses indicated lack of awareness of textual constraints and inability to remain within those constraints. These observations have been interpreted as indications of inability to regulate and verify their inference processes. Both regulation and verification have been related to the activities of the frontal lobes of the human brain by Luria. Thus, these observations appear to support the position that the psychological functions which Luria has identified with the frontal lobes of the human cerebrum play a crucial role in successful inference generation. Luria (1966b, p.286) has described the performances of patients with frontal lobe lesions on reading type tasks in the following manner:

> "These examples show...an inability to remain within the limits of the selective system of connections given by the text, a ready emergence of irrelevant connections, and an inability to inhibit these irrelevant connections."

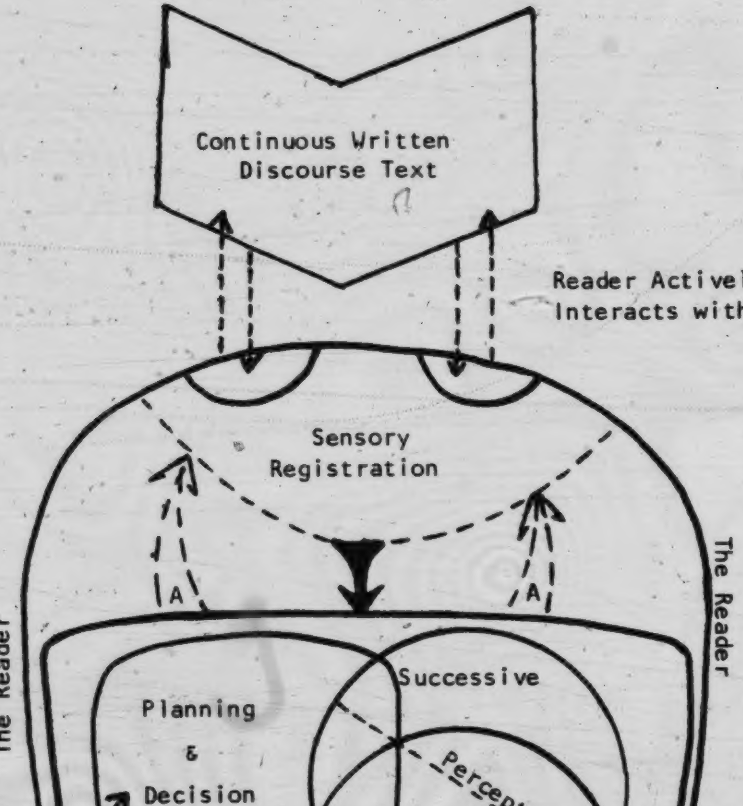
This statement appears to be equally descriptive of the Less Proficient Readers observed in the present investigation. It may be that the Less Proficient Reader is indeed unable to generate the appropriate cognitive strategies required for the confirmation of the inferences generated.

Most of the discussion of the findings of this investigation have been carried out within the theoretical framework developed in Chapter 2 which reflected theory and research from artificial intelligence, psycholinguistics, and neuropsychology. In the next section some observations will be made regarding a tentative theory of reading comprehension in light of the present investigation.

TOWARD A THEORY OF READING COMPREHENSION OF CONTINUOUS WRITTEN DISCOURSE

Current theoretical statements about reading tend to focus primarily on the word and sentence aspects. Only limited attention has been given to comprehension. Several recent writers (Goodman, 1972; Geyer and Kolers , 1974; Smith, 1975) have hypothesized that comprehension depends upon the four global sets of strategies which have been identified at the word and sentence decoding levels. Goodman (1972), in one of the earlier statements, identified the four cognitive strategies as (1) selection, (2) prediction, (3) confirmation, and correction. Geyer and Kolers (1974) identify the same strategies but have changed (2) "prediction" to "generation". Smith (1975) has re-emphasized the four strategies. All these writers have stressed that "prediction" or "generation" involves projecting meaning ahead "to select and organize the stimulus through active processing" (Geyer and Kolers, 1974, p.244). The findings of the present investigation would seem to indicate that in the instance of inference, the strategies of selection, and confirmation, as well as correction when needed, are just as crucial as prediction (the forward projecting of meaning) for efficient inference generation. In fact, Luria's concept of cognitive activities as a dynamicinteracting system appears very applicable. The successful generation of inference appears to be the result of the efficient interaction of selection, generation, confirmation, and correction strategies. This provides support for giving further recognition to the significant contribution the reader makes to reading. These two theoretical tenets appear to have implicationsfor the "Model of Information Integration" generated by Das, Kirby, and Jarman (1975) and discussed in Chapter 2, and for Ruddell's (1974) "Interpretation" component of his communication framework. These will be briefly discussed with illustrative figures.

The findings of this investigation have indicated some of the relationships between cognitive synthesis and inference. As well, the role of the Planning and Decision Making Unit has been hypothesized.


Continuous Written Discourse Text
Reader Actively Interacts with Text.
Sensory Registration
The Reader
The Reader
A
A
Planning & Decision Making
Successive
Perceptual
Conceptual
mnestic
Simultaneous
B
B
Covert Output
Simultaneous
Successive
C
C
Overt Output-
(Task Sensitive)

Feedback Systems:

A=Central
B=Covert Output
C=Overt Output

Figure 7.2 A REVISED INFORMATION INTEGRATION MODEL FOR READING

An overlapping of the Planning and Decision Making Unit with the cognitive synthesis units has been suggested. If the Model is to be applied to reading, the unidirectional flow of processing must be modified to allow for the reader's interaction with the written discourse within the constraints of his experiential background. Feedback systems thus appear essential. Further, it is suggested that the conceptual aspects of synthesis is based upon the interrelationship of the perceptual and mnestic aspects, and therefore has been placed between the perceptual and mnestic processes in the present representation. Figure 7.2 has attempted to incorporate these observations into the Das, et al (1975) model. In the present version, the processor has been identified as the reader.

The findings of this investigation also appear to have implications for the revision of the "Interpretation" component of Ruddell's model (1974), if it is to encompass comprehension of continuous discourse. The present findings provide support for labelling this entire component as "Interpretation". Even the reader's understanding of the author's explicitly stated textual information is interpretive in nature. Reponses by Less Proficient Readers indicated that the degree of their experiential background, real or vicarious, governed their interpretation of the author's written message.

This interpretive understanding of the author's intended message appears to be dependent upon a combination of analytical and integrative strategies. In Figure 7.3, this INTERPRETIVE UNDERSTANDING subcomponent has been divided into two parts by a broken line to indicate this interplay between anlaysis and integration. The findings from the inference tasks indicate that inference (an integrative strategy) is an integral

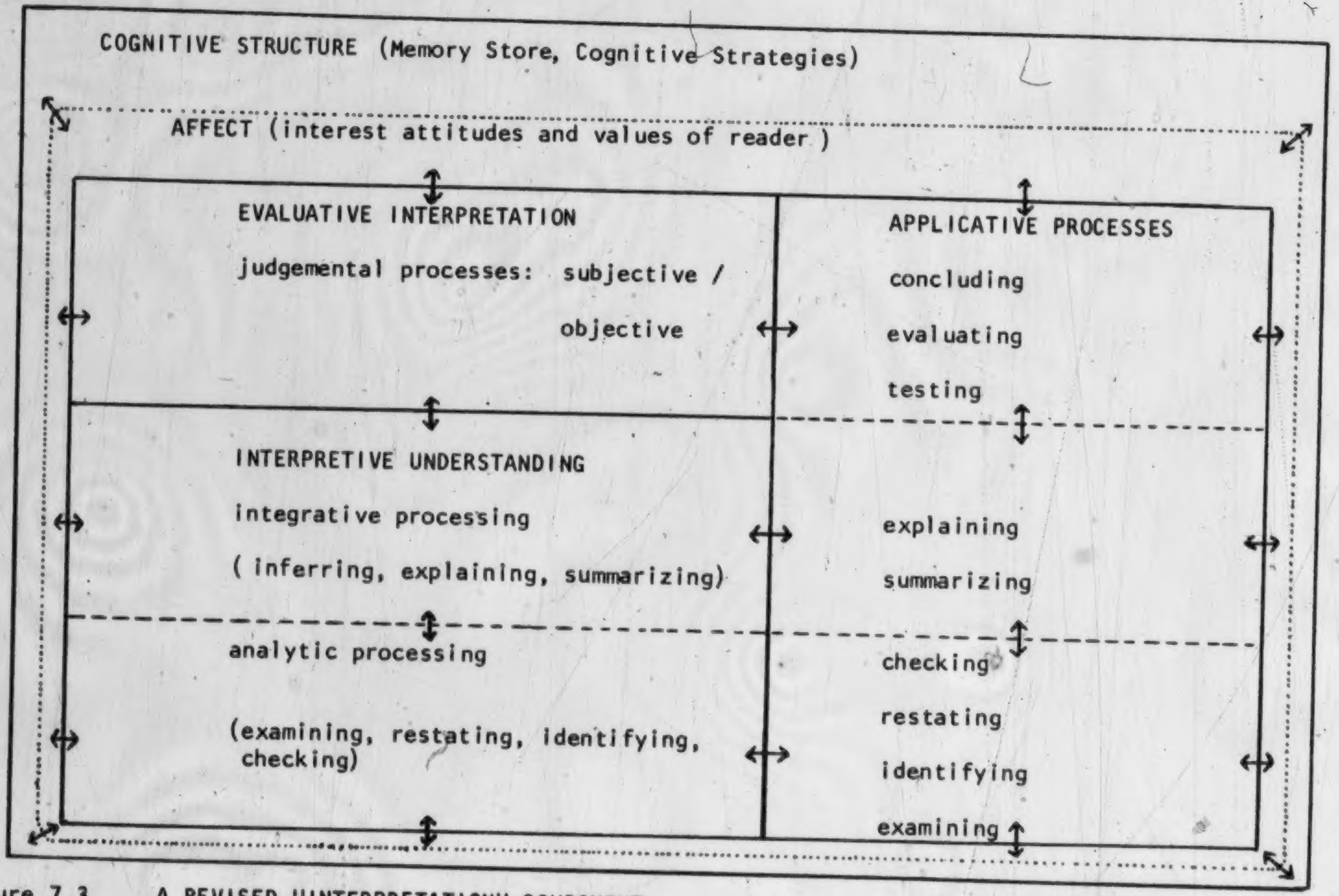

COGNITIVE STRUCTURE (Memory Store, Cognitive Strategies)
AFFECT (interest attitudes and values of reader)
EVALUATIVE INTERPRETATION
judgemental processes: subjective / objective
INTERPRETIVE UNDERSTANDING
integrative processing
(inferring, explaining, summarizing)
analytic processing
(examining, restating, identifying, checking)
APPLICATIVE PROCESSES
concluding
evaluating
testing
explaining
summarizing
checking
restating
identifying
examining

Figure 7.3 A REVISED "INTERPRETATION" COMPONENT

part of understanding. The responses of the subjects have also indicated that the inferences generated are dependent upon the reader's ability to analyse the given textual information, and also his ability to analyse whether his inference "makes sense" within the cognitive framework provided by the author's stated textual information.

Although EVALUATIVE INTERPRETATION was not the focus of this study, "Evaluative Strategies" is a component of Ruddell's (1974) model, and it has been included in this revision. In Figure 7.3 EVALUATIVE INTERPRETATION has been represented as a related, but separate subcomponent in which the focus of interpretation differes from understanding the author's intended message. These strategies, according to Ruddell (1974), involve the reader's judgement about the content and the style of the author's message. The responses of the subjects in this study seem to indicate a subjective level of evaluation for which they found it very difficult to express the criteria for their judgements. Thus, two categories of judgemental processes have been represented: subjective and objective. In the latter, one would expect the reader to be able to identify and state the criteria on which the judgement is based.

Ruddell (1974), and Ruddell and Bacon (1972) have indicated that a third aspect of comprehension involves the applicative strategies. This component of the revised model, APPLICATIVE INTERPRETATION, has been placed to the right of the other two subcomponents, and an attempt has been made to diagrammatically indicate how this aspect of interpretation spans the previously discussed two aspects of understanding and evaluation.

The suggestion has been made earlier (page 213) that the Less Proficient Reader may encounter difficulty in understanding an author's message because he may be unable to generate the cognitive strategies required for the confirmation of the inferences he is generating. Thus, comprehension is influenced by both the structure and processes of cognition. This aspect of comprehension has been represented by the large outer box in Figure 7.3. As well, the influence of the Reader's attitudes and interests has been noted in the responses of the subjects. This aspect has been represented in the figure by the dotted box identified as AFFECT. In an attempt to represent the complexity of the relationships and the interactive nature of the COGNITIVE STRUCTURE, AFFECT, and INTERPRETATION, an embedded relationship has been used in the illustration.

SUMMARY

This chapter has presented a discussion of the major findings,and observations of this exploratory study of inference and cognitive synthesis in comprehending continuous, narrative written discourse. The initial discussions were offered within the theoretical framework provided in Chapter 2. The value of the "Information Structure" theory of meaning to explore the aspects of textual information used by the maturing readers was presented. The relationships of successive and simultaneous synthesis and the generation of forward and backward-looking inferences has been indicated. A suggestion has been made that the psychological functions of programming, regulating, and verifying appear to be crucial dimensions of proficient inference generation. In addition, based on this investigation, suggested modifications have been offered for the Das, et al (1975) "Model of Information Integration", and the "Aspects of Meaning" and "Interpretation" components of Ruddell's (1974)"communications framework" model.

CHAPTER 8

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

The major purpose of the present research was to investigate the generation of inferences as an important integrative aspect of reading comprehension with selected fourth grade subjects whose performances on the Canadian Cognitive Abilities Tests indicated normal academic potential; performances on the Stanford Reading Achievement Tests indicated adequate reading vocabulary development (70th percentile or above), but less proficiency in reading comprehension (55th percentile or below). The performances of these subjects on selected cognitive synthesis tests, and reading related inference tasks were compared in this study with the performances of grade four subjects who were designated as very proficient in both reading vocabulary and reading comprehension (85th percentile or above) on the same standardized reading test.

In this chapter, a brief summary of the investigation will be given. This will be followed from the main findings from which conclusions have been drawn. Implication of the study will be presented in terms of reading theory, test construction, text preparation, and classroom instruction. Limitations of the study will be discussed, and recommendations for further research made. A concluding statement closes this chapter and the report of the study.

SUMMARY

This study was designed to explore the generation of inferences with a specific type of reader identified by Latham (1974) as one who has adequate vocabulary development but whose comprehension performance is less proficient. More specifically, the study investigated two kinds of inference identified by Schank (1975) as forward-looking and backward-looking. In addition, an attempt was made to relate the subjects' performances on the reading related inference tasks to their performances on tests of cognitive synthesis identified by Luria (1966a, 1966b) as successive and simultaneous.

The present study was carried out in two phases. Having identified the two kinds of inference as an aspect of reading comprehension which merited further research, the first phase involved the analyses of selected instructional materials, and the development of reading related inference tasks. Piloting of these tasks was also completed. In the second phase, data were collected on the subjects' performances on both the tests of cognitive synthesis, and the tasks of inference generation. The collected data were then analyzed both qualitatively and quantitatively, and when feasible appropriate statistical procedures were utilized to test the hypotheses developed in Chapter 1.

The instructional materials analyzed in the first phase included four texts. Two texts were selected from each of the Gage Language Strategies and the Nelson's Young Canada Readers Series. These materials were approved for use in the schools of the Province of Alberta. Analyses of these texts revealed that grade four students were required to answer both forward-looking, and backward-looking inferences in the prepared exercises. At the same time as the materials were being analyzed, nine narrative stimulus stories were developed by the investigator. Seven of these were selected for piloting. From the findings of the pilot studies, two stories were selected for use in the major study. These stories were analyzed and found to be comparable in terms of readability and story structure criteria.

Based on the stimulus stories, three reading-related inference tasks were developed. These were: (1) the Oral-Reading Inference Task (ORIT), (2) the Story-Recall Inference Task (SRIT), and (3) the Directional-Question Inference Task (DQIT). These tasks evolved out of two pilot studies.

The second major phase of the study involved the actual data collection and analyses. The data collection was carried out in two stages. First, all subjects completed two cognitive synthesis tests: Visual Short Term Memory (successive), and Memory For Design (simultaneous). Based on their performances on each of these tests, the subjects were ranked from highest to lowest, a double median split was performed, and four cognitive synthesis groups identified. These were: (1) the High Successive-High Simultaneous group, (2) the High Successive-Low Simultaneous group, (3) the Low Successive-High Simultaneous group, and (4) the Low Successive-Low Simultaneous group. These cognitive synthesis groups served as the framework for part of the analyses of the data generated by the subjects on the reading-related inference tasks.

The population from which the sample was selected consisted of 367 grade four students in five suburban elementary schools serving middle to upper middle class neighbourhoods in the Edmonton Public School system in Edmonton, Alberta. The sample consisted of twenty Less Proficient Readers, and twenty Very Proficient Readers purposively selected in terms of their performances on a standardized reading test (vocabulary and comprehension), and on academic potential (non-verbal

IQ). Equal numbers of boys and girls were selected in each of the proficiency groups.

Each subject completed the three reading-related inference tasks in an introspective-retrospective interview session which was tape-recorded, and later transcribed to typed protocols. These protocols were both qualitatively and quantitatively analyzed. The classification systems used in the qualitative analyses were developed by the investigator and reflected both theoretical viewpoints gleaned from the research literature, and the actual responses of the subjects. Wherever feasible appropriate statistical procedures were used to test the hypotheses developed in Chapter 1.

FINDINGS AND CONCLUSIONS

The findings and conclusions presented in this section have been drawn from both the preliminary phases, and the major study itself. Initially the findings related to the analyses of the instructional reading materials will be reported with the conclusions reached. The major part of this section will report the findings from the analyses of the data gathered in the major study. These findings with the conclusions will be discussed briefly in light of the research questions and hypotheses stated in Chapter 1.

Analyses of Instructional Materials

The analyses of the four instructional reading texts indicated that Schank's classification of inferences as forward-looking and backward-looking could be applied to the reading materials. The analyses of the inference questions posed in the texts revealed both forward-looking and backward-looking inferences were identified in all four instructional texts. A frequency count indicated the forward-looking inferences out numbered the backward-looking inferences almost two to one. From these findings it was concluded that inference is an integral part of the grade four instructional reading program; and that both forward and backward-looking inferences are required of the readers in the prepared exercises. As well, it was concluded that the present instructional programs appear to place greater emphasis on forward-looking inferences than on backward-looking inferences.

Analyses of Data Generated in Major Study

In this section the findings and conclusions based on the analyses of the data generated by the tests and tasks completed by the subjects in the major study will be presented and discussed briefly in light of the research questions and hypothesis postulated in the first chapter.

Question 1. Are there significant differences between the Very Proficient Readers and Less Proficient Readers, as defined in this study, in terms of the two types of cognitive synthesis identified by Luria (1966a) as successive synthesis and simultaneous synthesis?

H 1.1 There is no significant difference between the scores of the Very Proficient and Less Proficient Readers on the test of successive synthesis.

H 1.2 There is no significant difference between the scores of the Very Proficient and Less Proficient Readers on the test of simultaneous synthesis.

The scores of the subjects on the Visual Short Term Memory, and Memory for Design tests were analyzed to answer this question. The analyses included the chi-square and two-way analyses of variance for Reading Proficiency (A) X Sex (B).

A chi-square analysis of the distribution of the subjects in the four cognitive synthesis groups indicated a significant relationship between the levels of reading proficiency and the four cognitive synthesis groups. The Very Proficient Readers were found predominantly in the High Successive-High Simultaneous, and Low Successive-High Simultaneous synthesis groups. The majority of the Less Proficient Readers were classified as either High-Successive-Low-Simultaneous, or Low-Successive-Low-Simultaneous.

Further analyses using two-way ANOVA indicated no significant interaction due to reading proficiency and sex for either the successive or simultaneous synthesis scores. Similarily, no significant main effect for reading proficiency was revealed for the successive synthesis scores. However, a significant main effect due to reading proficiency was indicated for the simultaneous synthesis scores. The Very Proficient Readers attained a significantly higher mean score on the Memory for Design test than did the Less Proficient Readers.

From these findings it was concluded that the test of simultaneous synthesis appeared to be more related to the level of reading proficiency than the successive synthesis for the maturing grade four readers. Consequently, hypothesis 1.1 was not rejected, but hypothesis 1.2 was rejected.

Question 2. Are there significant differences between the boys and girls observed in this study in terms of the two types of cognitive synthesis, successive and simultaneous?

H 2.1 There is no significant difference between the scores obtained by the boys and the girls on the test of successive synthesis.

H 2.2 There is no significant difference between the scores obtained by the boys and the girls on the test of simultaneous synthesis.

The two-way ANOVA used to test the hypotheses generated from research question 1, was used also to test the hypotheses generated for research question 2.

As reported for question 1, no significant interaction effects for reading proficiency and sex were revealed by the two-way ANOVA for either the successive or simultaneous synthesis scores. Likewise, there was no significant main effect due to sex for either the two types of synthesis as tested by the Visual Short Term Memory, or Memory for Design tests. From these findings it was concluded that the boys and girls observed in this study did not differ in their abilities of successive and simultaneous synthesis. This would appear to be one of the first studies to explore the possibility of sex differences for the two types of cognitive synthesis identified as successive and simultaneous. Most of the previous research reviewed had been carried out only with male subjects. As a result of these findings hypotheses 2.1 and 2.2 were not rejected.

Question 3. Are there significant differences among the four cognitive synthesis groups, as defined for this investigation, in terms of the four criterion variables, non-verbal IQ, chronological age, reading vocabulary, and reading comprehension?

H 3.1 There are no significant differences among the four cognitive synthesis groups in terms of
.11 non verbal IQ scores
.12 chronological age in months
.13 reading vocabulary percentile scores
.14 reading comprehension percentile scores

The data gathered from the students' cumulative record cards were used to answer this question. A two-way ANOVA for successive synthesis (A) X simultaneous synthesis (B) was used to test the hypothesis.

In each of the four analyses, there was no significant interaction between the successive and simultaneous synthesis factors. For both non-verbal IQ and chronological age, there were no significant main effects due to either successive or simultaneous synthesis. Likewise when the reading vocabulary, and comprehension scores were analyzed, no significant main effect for successive synthesis was revealed. However, there was a significant main effect due to simultaneous synthesis for both vocabulary and comprehension. The high simultaneous groups were significantly higher on their mean percentile standing than the low simultaneous groups.

From these findings it was concluded that the four cognitive synthesis groups did not differ significantly in terms of academic potential as measured by non-verbal IQ; nor did they differ on their chronological ages. The four groups did differ in their standings on reading vocabulary and reading comprehension. These findings reflected the significant relationship between the proficiency levels and simultaneous synthesis scores. The High Successive-High Simultaneous, and Low Successive-High Simultaneous groups were significantly superior to the High Successive-Low Simultaneous, and Low Successive-Low Simultaneous groups. Accordingly, hypotheses 3.11 and 3.12 were not rejected, but hypotheses 3.13 and 3.12 were rejected since the high simultaneous groups attained significantly higher mean scores than the low simultaneous groups.

Question 4. Are there significant differences among the four cognitive synthesis groups in terms of the quantity of forward and backward-looking inferences generated, and the quality of inferences generated in a self structured reading situation?

H 4.1 There are no significant differences among the four cognitive synthesis groups in terms of the number of inferences generated that are
.1 forward-looking in nature
.2 backward-looking in nature

H 4.2 There are no significant differences among the four cognitive synthesis groups in terms of the number of supported inferences generated.

To answer this question, the frequency data generated by the subjects on the Oral-Reading Inference Task (ORIT) and the Story-Recall Inference Task (SRIT) were analyzed. In these tasks the reader determined for himself if and when he would inference. To test the hypothesis generated by this research question, the frequency counts for each category were transformed to percentage scores using the subject as his own control, and these transformed scores were submitted to a two-way ANOVA for successive synthesis (A) X simultaneous synthesis (B).

No significant interactions between successive and simultaneous synthesis were found for the analyses of either the ORIT or SRIT data. Nor were there any significant main effects due to successive or simultaneous synthesis for either the number of forward or backward-looking inferences generated on ORIT. Likewise, there were no significant main effects due to the two kinds of synthesis for either the number of forward or backward-looking inferences generated on SRIT. Similarly, there were no significant main effects due to the kind of synthesis for the number of supported inferences generated. From these findings,it was concluded that the four cognitive synthesis groups did not differ significantly in terms of the number of inferences that were generated and identified as (1) forward-looking, or (2) backward-looking. Likewise the four groups did not differ significantly in terms of the number of supported inferences generated in the self-structured reading situations of ORIT or SRIT. Hypotheses 4.1 and 4.2 were not rejected.

Question 5. Are there significant differences within each of the four cognitive synthesis groups in terms of the quantity and quality of the inferences generated in a self-structured reading situation?

H 5.1 There are no significant differences within the High-Successive-High-Simultaneous group on terms of

.11 the quantity of forward and backward-looking inferences
.12 the number of supported forward-looking inferences
.13 the number of supported backward-looking inferences

H 5.2 There are no significant differences within the High-Successive-Low-Simultaneous groups in terms of
.21 the quantity of forward and backward-looking inferences
.22 the number of supported forward-looking inferences
.23 the number of supported backward-looking inferences

H 5.3 There are no significant differences within the Low-Successive-High-Simultaneous group in terms of
.31 the quantity of forward and backward-looking inferences
.32 the number of supported forward-looking inferences
.33 the number of supported backward-looking inferences

H 5.4 There are no significant differences within the Low-Successive-Low-Simultaneous group in terms of
.41 the quantity of forward and backward-looking inferences
.42 the number of supported forward-looking inferences
.43 the number of supported backward-looking inferences

To answer this question the transformed percentage scores obtained from the frequency data generated by the subjects on the Oral-Reading Inference Task (ORIT) and the Story-Recall Inference Task (SRIT) were again analyzed. Because of the dependency created by the transformation procedures, the non-parametric Signs Test was used to test the hypotheses generated from this research question.

The analyses of the ORIT data revealed that there was no significant difference between the quantity of forward-looking and backward-looking inferences generated for each of the four cognitive synthesis groups.

In the comparison of the supported and non-supported forward-looking inferences, it was revealed that the High Successive-High Simultaneous, and Low Successive-High Simultaneous groups generated significantly more supported than non-supported inferences. For the High Successive-Low Simultaneous, and Low Successive-Low Simultaneous groups no significant difference was found for the number of supported and non-supported forward-looking inferences.

When supported and non-supported inferences were compared for the backward-looking category, it was revealed that all four cogntive synthesis groups generated significantly more supported than non-supported backward-looking inferences on ORIT.

The analyses of the SRIT data revealed somewhat similar findings. There was no significant difference for each of the four cognitive synthesis groups in terms of the number of forward and backward-looking inferences generated. The same finding was indicated for the comparison of supported and non-supported forward-looking inferences. Once again, for the backward-looking inferences, each of the cognitive synthesis groups generated significantly more supported than non-supported inferences.

From these findings,it was concluded that the forward and backward-looking inferences differ in the degree of contextual contraint they impose on the reader. The backward-looking inference appears to be more textually constrained, and all groups of subjects generate more supported inferences in this situation. The forward-looking inference does not appear to impose the same degree of constraint upon the reader. Without the textual focus of the task the High Successive-Low Simultaneous and Low Successive-Low Simultaneous groups were found to generate as many unsupported as supported forward-looking inferences. These two groups were predominantly the Less Proficient Readers. For the High Successive-High Simultaneous group, and the Low Successive-High Simultaneous group, it was concluded they made greater use of textual information, since they generated more supported than non-supported forward-looking inferences. These subjects were mostly the Very Proficient Readers. The ability to remain within the constraints of the given text, differentiated the high simultaneous groups from the low simultaneous groups.

Consequently hypotheses 5.11, 5.21, 5.31, and 5.41 were not rejected. Nor were hypotheses 5.22 and 5.42 rejected. However hypotheses 5.12 and 5.32 were rejected, as were hypotheses 5.13, 5.23, 5.33 and 5.43.

Question 6. Are there significant differences among the four cognitive synthesis groups in terms of (1) the kind of inference; (2) the acceptability of the inferential responses; (3) the use of textual support for those responses; and (4) the verbalized linking of the support to the inferential response in a question structured situation?

H 6.1 There are no significant differences among the four cognitive synthesis groups in a question structured situation in terms of

.1 the scores for forward-looking inference
.2 the scores for backward-looking inferences
.3 the scores for the number of acceptable responses
.4 the scores for the textual support of the inferences
.5 the scores for the verbalized linking of textual information to inferential response

The subjects' scores for their verbalized responses to the questions posed by the investigator on the Directional-Question Inference Task (DQIT) were analyzed to answer this question. The data were submitted to a two-way ANOVA for successive (A) by simultaneous synthesis (B) to test the hypotheses.

No significant interaction effects were revealed for the analyses of the five sets of scores. For the forward-looking inference scores there was no significant main effect due to successive synthesis; however, there was a significant main effect due to simultaneous synthesis. The High-Simultaneous groups were significantly higher than the Low-Simultaneous groups on their mean forward-looking inference score.

For the backward-looking inference score, a significant main effect due to successive synthesis was indicated, but no significant main effect due to simultaneous synthesis. It was found that the High-Successive groups performed significantly below the Low-Successive synthesis groups. This finding has been discussed in detail in Chapter 7.

For the acceptability scores, the support scores, and the scores for verbalized linking, there were no significant main effects due to either successive or simultaneous synthesis.

From these findings,it was concluded that ability in cognitive synthesis was significantly related to success in generating inferences in question structured situations. The two types of synthesis were related to the two types of inference. In the instance of simultaneous synthesis and forward-looking inference questions, the relationship was positive. High achievement on the former was a significant factor in high achievement on the latter.

However, for backward-looking inference questions and successive synthesis the relationship was negative. High achievement on successive synthesis was related to lower achievement on the backward-looking inference questions. This was interpreted as an indication that the successive synthesis strategies were detrimental to filling information gaps, or bridging given information. Successive synthesis does not appear to be an appropriate integrative strategy for the backward-looking inference.

Hence, hypotheses 6.11 and 6.12 were rejected as there were significant differences between the scores for the two types of inference and the two kinds of cognitive synthesis. However, hypotheses 6.13, 6.14, and 6.15 were not rejected by the findings.

Question 7. Are there differences among the four cognitive synthesis groups in terms of (1) reader interaction with the text, (2) kind of information used to generate inferences, and (3) proficiency in story recall?

H 7.1 There are no significant differences among the four cognitive synthesis groups in terms of
.11 the total number of verbalized interactions with the text
.12 the number of inferential verbalizations and the number of translation verbalizations

H 7.2 There are no significant differences among the four cognitive synthesis groups in terms of the number of inferential responses identified as
.21 word based
.22 sentence based
.23 beyond sentence based

H 7.3 There are no significant differences among the four cognitive synthesis groups in terms of the number of story units identified in the story recall protocols

Only one statistical hypothesis was tested for this question. This was for proficiency in story recall generated on SRIT. In this instance the data generated were sufficiently stable to permit a statistical test. In this case a two-way ANOVA for Successive (A) by Simultaneous (B) synthesis was computed.

The findings revealed there was no significant interaction effect. Nor was there a significant main effect due to either successive or simultaneous synthesis. Therefore, it was concluded that the memorial abilities of the four cogntive synthesis groups did not differ significantly. Hypothesis 7.3 was not rejected based on these findings.

Reader interaction with text, and kind of information used to generate infereces were both explored in terms of the data generated by the subjects on ORIT. The data varied considerably within groups, and the classification system was quite global. Therefore, these aspects of question 7 were explored by transforming the frequency counts to percentages, and intuitively comparing same.

As an estimate of interaction with the ideas expressed by the text, the number of inferential responses, and translative responses were totaled for each group and transformed to percentage in terms of the grand total for all the groups. When this was computed it was found the High Successive-High Simultaneous ranked highest followed by the Low Successive-Low Simultaneous group, and then the Low Successive-High Simultaneous, and finally the High Successive-Low Simultaneous. The range of differences in the percentages was not large (20 - 30%). It was concluded that there was little difference among the four cognitive synthesis groups in terms of amount of interaction with the text.

For the kind of information used to generate inferences, the frequency counts in the three categories identified by the investigator were transformed to percentages and comparisons made. In all four groups a similar pattern emerged. The highest percentage was computed for sentence level information. The second highest was the beyond sentence level, and the lowest was the word level. From these findings it was concluded that all four cognitive synthesis groups were generating inferences primarily from information at or beyond the sentence level. Although this was clearly a reflection of the task, it does indicate that these maturing readers are linking across and beyond single sentences.

Question 8. Are there significant differences between the Very Proficient and Less Proficient Readers in terms of the quantity of forward and backward-looking inferences generated and the quality of inferences generated in self-structured reading situations?

H 8.1 There is no significant difference between the Very Proficient and Less Proficient Readers in terms of the number of inferences generated that are
.11 forward-looking in nature
.12 backward-looking in nature

H 8.2 There is no significant difference between the Very Proficient and Less Proficient Readers in terms of the number of supported inferences generated.

The data generated by the subjects on the Oral-Reading Inference Task (ORIT) and the Story-Recall Inference Task (SRIT) were transformed into percentage scores and analyzed to answer this question. Independent t-tests were used to test the statistical hypothesis.

No significant difference was revealed between the Very Proficient and Less Proficient Readers for the number of forward-looking inferences generated on both the ORIT and SRIT. Likewise, no significant difference was revealed between the two levels of reading proficiency and the number of backward-looking inferences generated on ORIT and on SRIT.

When the two reading proficiency levels were compared on the number of supported inferences generated, it was found that the Very Proficient generated significantly more supported inferences than did the Less Proficient Readers on ORIT. However, this same comparison on the SRIT data revealed no significant difference in the number of supported inferences for the Very Proficient and Less Proficient Readers.

Hence, it was concluded that both Very Proficient and Less Proficient Readers generate both forward and backward-looking inferences when reading continuous narrative discourse. Subjects at both levels of proficiency appear to generate both forward-looking and backward-looking inferences with similar degrees of probability. Likewise, both types of inference were generated by the Very Proficient and Less Proficient Readers in the SRIT protocols.

Although the two reading proficiency groups did not differ significantly in terms of the number of inferences generated in each category, they did differ significantly on the number of textually supported inferences generated on ORIT. The Very Proficient appeared to be more textually aware, and able to function within the constraints of the story context when they generated inferences. The Less Proficient Reader often inferred beyond the contraints of the story, and drew heavily on his experiential background rather than the information generated from the text. However, the analyses indicated no significant difference between the Very Proficient and Less Proficient in terms of supported inferences on the SRIT protocols. The inconsistency of the findings for supported inferences on ORIT and SRIT was attributed to the nature of the tasks, and will be discussed at greater length in the next question.

Hypotheses 8.11 and 8.12 were not rejected. Hypothesis 8.2 was partly rejected. There was a significant difference between proficiency groups for supported inferences on ORIT but not on SRIT.

Question 9. Are there significant differences within the Very Proficient and Less Proficient groups of Readers in terms of the quantity and quality of the inferences generated in self-structured reading situations?

H 9.1 There is no significant difference within the Very

Proficient group of readers in terms of
.11 the quantity of forward and backward-looking inferences
.12 the number of supported forward-looking inferences
.13 the number of supported backward-looking inferences

H 9.2 There is no significant difference within the Less Proficient group of readers in terms of
.21 the quantity of forward and backward-looking inferences
.22 the number of supported forward-looking inferences
.23 the number of supported backward-looking inferences

To answer this question the data generated by the subjects on the Oral-Reading Inference Task (ORIT) and the Story-Recall Inference Task (SRIT) were analyzed using a Signs Test to determine significance and so test the statistical hypothesis.

As in question 8, the differences in the nature of the two tasks (ORIT and SRIT) appeared to influence the findings. Therefore, the analyses of these tasks will be discussed separately.

On ORIT the Very Proficient Readers generated significantly more forward than backward-looking inferences. There was no significant difference between the number of forward and backward-looking inferences generated by the Less Proficient Readers.

When the forward-looking inferences were re-analyzed for textual support, it was revealed that the Very Proficient Readers generated significantly more supported than non-supported inferences in this category. However, the analyses of the Less Proficient Readers responses indicated no significant difference between supported and non-supported forward-looking inferences. On the other hand, both the Very Proficient and Less Proficient Readers generated significantly more supported than non-supported backward-looking inferences on ORIT.

From these findings, it was concluded that the Very Proficient Readers were more aware of textual constraints, and were more able to remain within these constraints when generating both forward and backward-looking inferences. Further, it was concluded that the Less Proficient Readers were less aware of the textual constraints of the story, and less efficient in remaining within the textual constraints when generating forward-looking inferences. However, they generated more textually supported backward-looking inferences. From this it was concluded that the two kinds of inference differed in the degree of textual constraint imposed on the reader. Backward-looking inferences appear to be more textually constrained and therefore require, by their nature, textual support.

Analyses of the SRIT protocols revealed that there was no significant difference for both the Very Proficient and Less Proficient Readers in terms of the quantity of forward-looking and backward-looking inferences generated. However, a significant difference was revealed for the support/non-support analyses for both forward-looking and backward-looking inferences. For each type of inference, both the Very Proficient and the Less Proficient Readers generated more supported than non-supported inferential responses.

From these findings, it was concluded that the Very Proficient and Less Proficient Readers generated both forward and backward-looking inferences as integral components of their memory for stories. It was concluded also that the inferences stored in story memory were predominantly the essential, textually supported inferences. Further it was concluded that the ability to use textual information to support inferences generated varies with the nature of the inference task.

As a result of these findings, hypotheses 9.11 was rejected. The Very Proficient Readers generated more forward-looking inferences than backward-looking inferences on ORIT but not on SRIT. Hypotheses 9.21 was not rejected. Hypotheses 9.12 was rejected, the Very Proficient generated more supported than non-supported forward-looking inferences. Hypotheses 9.22 was not rejected. Hypotheses 9.13 and 9.23 were both rejected; both the Very Proficient and the Less Proficient Readers generated more supported than non-supported backward-looking inferences.

Question 10. Are there significant differences between the Very Proficient Readers in terms of (1) the kind of inference, (2) the acceptability of the inferential response, (3) the use of textual support for the responses, and (4) the verbalized linking of the support to the inferential responses in a question structured situation?

H 10.11 There is no significant difference between the Very Proficient and Less Proficient Readers in terms of the DQIT forward-looking inference scores.

H 10.12 There is no significant difference between the Very Proficient and Less Proficient Readers in terms of the DQIT backward-looking inference scores.

H 10.13 There is no significant difference between the Very Proficient and Less Proficient Readers in terms of their scores for acceptable responses.

H 10.14 There is no significant difference between the Very Proficient and the Less Proficient Readers in terms of their scores for support of the inferential responses.

H 10.15 There is no significant difference between the Very Proficient and Less Proficient Readers in terms of their scores for verbalized linking of textual support and verbalized inferential response.

To answer this question the data generated by the subjects on the Directional-Question Inference Task (DQIT) were analysed. Means and standard deviations were derived, and an independent t-test was performed to test the statistical hypotheses.

The findings revealed by the independent t-tests indicated the Very Proficient Readers generated significantly higher mean scores for both forward and backward-looking inferences than did the Less Proficient Readers. Further, the Very Proficient Readers produced significantly higher mean scores for acceptable responses, attained significantly higher mean scores for textual support, and were able to verbalize the linking of textual support to their inferential responses with a significantly higher level of proficiency than did the Less Proficient.

From these findings,it was concluded that the Very Proficient Readers performed significantly better than the Less Proficient Readers in a question structured situation on both forward and backward-looking inferences. The Very Proficient were more aware of the textual information provided, and the constraints this information imposed to generate acceptable inferential responses. They also appeared to be more aware of the relationship between their responses and the textual information.

The Very Proficient readers appear to have made more efficient use of the support provided by the question to focus on appropriate textual information and so produce acceptable inferences. For the Less Proficient Readers this was not always the case. Although the question focused their response, they did not use the information provided by the question to select the textual support information. While the Very Proficient Reader referred to the text to support their answers, the Less Proficient Readers responded more often without reference to the text. When directed to the text, they responded that there was no information there to provide the answer. This was interpreted as an indication that the subject was unable to select appropriate textual information crucial to the generation of an acceptable inference. In addition, the Less Proficient Readers were less able to remain within the constraints of the given text. Their experiential background seemed at times to block out the textual information, and thus reflected a more egocentric level of thinking. The reference to experiential background often resulted in difficulty in knowing when to stop making inferences. The weaknesses of the Less Proficient Readers and the strengths of the Very Proficient Readers appear to be directly related to the psychological functions identified by Luria as formation of intentions and programs, and decision making. A more detailed discussion of this observation has been provided in Chapter 7.

Based on these findings,hypotheses 10.11, 10.12, 10.13, and 10.14 have been rejected. The Very Proficient Readers were significantly superior to the Less Proficient Readers in all comparisons.

Question 11. Are there significant differences between the Very Proficient and Less Proficient groups of readers in terms of (1) reader interaction with the text, (2) the kind of textual information used to generate inferences, and (3) proficiency in story recall?

H 11.1 There is no significant difference between the Very Proficient and Less Proficient Readers in terms of
.11 the total number of verbalized interactions with the text on ORIT
.12 the number of inferential verbalizations, and the number of translation verbalizations.

H 11.2 There is no significant difference between the Very Proficient and Less Proficient Readers in terms of the number of inferential responses identified as
.21 word based
.22 sentence based
.23 beyond sentence based.

H 11.3 There is no significant difference between the Very

> Proficient and Less Proficient Readers in terms of the number of story units identified in the story recall protocols.

A statistical hypothesis was tested for only the story recall data since they were stable enough to permit the use of a statistical technique to test the hypothesis. An independent t-test was used to test for significance of differences found between the Very Proficient and Less Proficient Readers.

The finding revealed a significant difference in favour of the Very Proficient Readers. From this finding it was concluded that superior memorial abilities was one distinguishing factor for the Very Proficient Readers. Hypothesis 11.3 was rejected on the basis of this finding.

The data generated for reader interaction with the text, and the kind of information used to generate inferences was based on the ORIT analyses. As reported previously, this data was not amendable to statistical tests. Thus, the frequency counts for each reading proficiency level were transformed into percentages for descriptive purposes.

When the total inferential and translative responses were compared for the Less Proficient and Very Proficient Readers in terms of the grand total for the sample, it was found that the Very Proficient Readers had a higher percentage than the Less Proficient. The significance of this difference could not be determined. But it would appear to be a factor which might provide some useful insights if further researched.

Comparisons of the three categories of information (word level, sentence level, beyond sentence level) for the two proficiency groups revealed the same pattern as was found for the cognitive synthesis groups. The highest percentage was computed for sentence level information. The second highest was beyond sentence level, and the lowest percentage was calculated for the word level.

Based on these findings, it was concluded that both Very Proficient and Less Proficient Readers were processing the story units at the sentence and beyond sentence levels. The measures used in this analyses are very global in nature, and further research is required before conclusions could be generalized.

ADDITIONAL LIMITATIONS OF THE STUDY

The major limitations of this study were stated in Chapter 1. However, in the course of the analysis of the data other limitations have arisen which the reader should keep in mind when interpreting the findings and conclusions of this study.

First, the size of the sample was relatively small (N=40). When the sample was categorized into four cognitive synthesis groups, each sub-group had only 10 subjects. Because of the small numbers, and considerable variability within groups, the error term in the analysis of variance was often very large, and may have masked the significance of some of the observed differences.

Second, the decision to change the frequency counts of the ORIT and SRIT data to percentages, and the use of each subject as his own control in this process has created dependencies among some of the scores. This has been noted in the discussions of Chapters 5 and 6. These dependencies have limited the use of more powerful statistical treatments for some of the tests, and may have confounded some of the findings.

Finally, the very significant relationship revealed between reading proficiency and simultaneous synthesis has made it difficult to interpret some of the findings related to cognitive synthesis and inference. This confounding may be reflected in some of the conclusions reached.

IMPLICATIONS

Within the limitations set out for this study of inference, the following implications have been drawn from the findings. Included are implications for reading theory, teaching reading, preparation of reading texts, reading tests, and teacher preparation.

Reading Theory

Chapter 7 of this report has been devoted to a discussion of the theoretical aspects of this study. Therefore, this section will provide only a brief summary, and the reader is referred to Chapter 7 for more detailed discussion.

Recently, both MacGinitie (1975) and Miller (1975) have recommended research designed to extend and elaborate reading comprehension theory beyond the level of sentence syntax. The present study has provided support for the inclusion of inference as an integral component for any theory of text comprehension. In their verbalized introspective and retrospective responses to indicate their understanding of sentence relationships and larger organizational structures of the narrative stories used in this study, both the Very Proficient and the Less Proficient Readers generated inferences.

The findings of the present study have indicated support for the psychological reality of Schank's distinction between forward and backward-looking inferences. The complexity of the inference processes has been demonstrated. A theory of inference in reading comprehension must recognize this complexity and incorporate both forward and backward-looking inferences.

The relationship between cognitive synthesis and forward and backward-looking inferences has been indicated for question structured tasks. The importance of simultaneous synthesis for making forward-looking inferences has been shown. The negative influence of successive synthesis on backward-looking inferences has also been revealed. This relationship between cognitive synthesis and inference needs to be incorporated into a theory of reading comprehension which reflects these underlying cognitive processes.

Support for a theory of reading comprehension which reflects the interaction of the reader with the reading material has also been demonstrated. The complexity of inference and the reading process has been underscored.

Teaching Reading

Throughout this study its exploratory nature has been stressed. As well, it has been pointed out that the research procedures reflect clinical rather than classroom teaching procedures. Thus, the implications of the present study for the teaching of reading are limited and focus primarily on the teacher's knowledge and awareness.

First teachers need to know that all inferences do not make the same cognitive demands on the reader. They need to recognize the importance of both forward and backward-looking inferences in assisting the reader to integrate story information. Instructional opportunities for both forward-looking and backward-looking inferences need to be provided in the elementary reading program. Both the Less Proficient and the Very Proficient Readers have demonstrated in the present study that they generate both forward and backward-looking inferences when they read continuous written discourse. Analyses of currently used reading texts have indicated a greater emphasis on the forward-looking inferences. Teachers need to be aware of this situation, and need to provide additional opportunities for the development of the maturing reader's abilities in generating backward-looking inferences.

There is a growing body of literature which indicates the importance of inference in text comprehension. The present study has provided additional support for this viewpoint. As well, this study has indicated that confirmation strategies, rather than prediction strategies differentiated the Very Proficient Readers from the Less Proficient Readers. Teachers need to be aware of the importance of confirmation strategies in inference generation. Classroom teachers need to provide instructional opportunities which will guide the maturing reader to develop and use confirmation strategies to enhance efficient interpretation of continuous written discourse.

Instructional Materials

The analyses of the selected instructional reading materials in this study indicated that both forward and backward-looking inferences were found in the prepared exercises. No distinction was made between the forward and backward-looking inferences. Persons preparing text materials for instruction in inference need to recognize that there are differences between the two types of inference. More exercises designed to develop the ability to generate backward-looking inferences are needed. Recognition of the characteristics of the two types of inference will allow persons who are preparing instructional materials to build in opportunities to make backward-looking inferences, as well as forward-looking inferences.

Reading Test Construction

Persons responsible for the development of reading comprehension tests also need to be aware of the distinction between forward and backward-looking inferences, and ensure that both types are included in the test items. The inclusion of this distinction could add to the diagnostic potential of such tests. The difficulty level of the reading test could be influenced by the number of forward or backward-looking inferences. For the Less Proficient Reader, the former appear to be more difficult.

Teacher Preparation

Educators who are responsible for the preparation of classroom teachers need to be aware of the differences, and the complexities which exist in the area of inference. Opportunities need to be provided in preparatory courses in reading instruction which will develop the potential classroom teacher's awareness of forward and backward-looking inferences, and the importance of these two types of inference in comprehending continuous written discourse. Teachers in training need also to become aware of the importance of confirmation strategies for effective comprehension. Opportunities for developing appropriate instructional strategies need to be provided in these areas.

SUGGESTIONS FOR FURTHER RESEARCH

The findings of the present study of inference and cognitive synthesis with selected maturing readers have indicated that forward and backward-looking inferences do differ in the demands that they make on the young reader. Proficiency in reading has been positively related to success in making both kinds of inferences. Significant differences have been indicated between the two types of cognitive synthesis abilities and performance on the two types of inference. However, these findings have been generated by a limited size sample. The sample size in the present study was dictated in part by the introspective-retrospective interview procedure which is quite time consuming to administer. Therefore, replication of the study with the same type of subjects is needed to confirm the stability of the present findings. Either a larger sized sample is needed, or multiple relications which could be combined to provide greater stability in the data generated.

The developmental aspects of both inference and cognitive synthesis need to be explored. The present study has been carried out with selected fourth grade students. This type of study needs to be carried out with other types of fourth grade readers (i.e. the reader with average ability in both vocabulary and comprehension; the reader who is below average in both vocabulary and comprehesnion). As well, such studies are needed with younger children (grades 1,2,3), and with older children (grades 5,6,7,8). Inference processes need to be studied for the high school reader, and the mature adult reader, as well.

Studies designed to explore whether the abilities related to forward and backward-looking inferences can be taught are needed. Teaching strategies for the two kinds of inference need to be developed. Evaluation of the effectiveness of such strategies is also required.

The present study has considered only narrative continuous discourse. Studies of this nature need to be carried out with other types of writing (i.e. argumentative; expository materials). These studies need to be carried out for different age levels as well.

The present study was carried out on the assumption that all the subjects were at a similar level of cognitive growth according to Piaget's schema of development. Studies which actually link subjects' abilities in the two types of inference with Piaget's tests of conservation, classification, deduction, induction, and probability may provide useful insights into the developmental processes related to the generation of inferences.

The relationship of a reader's cognitive style and his ability to generate forward and backward-looking inferences is another research area that needs to be explored. The relationship of cognitive style and cognitive synthesis also needs to be studied.

Further, differences between the Very Proficient and Less Proficient Readers, as defined in this study, could be explored with the aid of a modern eye-movement camera. Such studies may provide useful insights into the inference process, if introspectively reported inferences were compared with eye movement activity.

Finally, the suggestion has been made in this study that inference is dependent upon the psychological functions of formulating intentions and programs, and decision making (i.e. which information to use for an inference, and when to stop inferencing). Luria has identified these functions with the frontal lobes of the human brain. Research methods for measuring the levels of development in these functions is much needed to explore further their relationships to the processes of inference. Such methods need to be developed and validated, so that further insights may be provided into the reading processes.

CONCLUDING STATEMENT

In this exploratory study, two types of inference identified as forward-looking and backward-looking (Schank, 1975) have been investigated through the analyses of selected fourth grade subjects' introspective-retrospective verbalized responses on three reading-related inference tasks. The major conclusions from the findings of this sudy have been summarized in Table 8.1.

The data generated by the introspective-retrospective interview sessions have revealed useful insights into how Very Proficient Readers (85 percentile or above on both reading vocabulary and reading comprehension on a standardized test) and Less Proficient Readers (70 percentile or above on reading vocabulary, and 55 percentile or below on reading comprehension) process continuous narrative written discourse to generate both forward and backward-looking inferences.

The findings of the present investigation have provided experimental evidence to support Schank's (1975) theoretical distinction between forward and backward-looking inferences. In addition, the findings related to the Directional-Question Inference Task (DQIT) have

Table 8.1 SUMMARY OF MAJOR CONCLUSIONS DRAWN FROM THE STUDY

1. The generation of both forward and backward-looking inferences is an integral part of commercially prepared reading comprehension programs; however, a greater emphasis appears to be placed on the forward-looking inferences.
2. Abilities in simultaneous synthesis rather than successive synthesis appear to discriminate levels of reading proficiency for maturing grade four readers.
3. Abilities in successive and simultaneous synthesis do not appear to differ across boys and girls.
4. The number of inferences generated in self-structured reading tasks does not appear to differ across groups of varying cognitive abilities, or levels of reading proficiency.
5. Forward and backward-looking inferences differ in the amount of contextual constraint imposed upon the reader. The latter appear to be more constrained by the text.
6. Cognitive synthesis appears to be a significant factor in the generation of inferences in question-structured inference tasks. Simultaneous synthesis appears to be a positive factor in the generation of forward-looking inferences. Successive synthesis appears to be a negative factor in the generation of backward-looking inferences.
7. Maturing grade four readers use a variety of kinds of textual information when generating inferences while reading continuous written discourse.
8. Both forward and backward-looking inferences appear to be generated as integral components of readers' story-recall protocols. These inferences are textually supported.
9. Very Proficient Readers use textual information, and remain within the constraints of that information more efficiently than Less Proficient Readers on question-structured inference tasks related to continuous written discourse.
10. When compared with Less Proficient Readers, the Very Proficient Readers appear to possess superior memorial abilities.

indicated a significant relationship between these two kinds of inference and the two types of cognitive synthesis identified by Luria (1966a) as successive and simultaneous. The present study has confirmed and illuminated Ruddell's theoretical communications framework.

The emphasis placed by some psycholinguists (Smith, 1971,1975; Geyer and Kolers, 1974) on prediction as the key to efficient reading comprehension has been challenged. The findings of this investigation have indicated that confirmation strategies, rather than prediction strategies, distinguished the Very Proficient Readers from the Less Proficient Readers.

Current Reading texts at the fourth grade level appear to provide more activities related to forward-looking inferences. The present study calls for the recognition of backward-looking inferences in both instructional materials and procedures. No longer can inference be treated as a single entity. This exploratory investigation has examined only limited aspects of the complexity of inference in reading comprehension. Further research into this essential aspect of reading comprehension is urgently needed.

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APPENDICES

APPENDIX A

SUCCESSIVE SYNTHESIS

Visual Short Term Memory Test

.1 Administrative Guidelines

.2 Scoring Guidelines

.3 Procedural Illustration

SUCCESSIVE SYNTHESIS

(Visual Short Term Memory Test)

.1 Administrative Guidelines

A. Arrange desks prior to administration. Set up slide projector and screen. Check that all is in working order.

B. Seat subjects so each has clear view of screen (not more than 20 feet from it.)

C. Distribute response booklets with pencils and erasers.

D. Have subjects complete identification information on front cover of booklet (Name, Sex, Grade, School, Date).

E. Give verbal description of task:

"First let me tell you about the task we are going to do together, then I will show you how it is done.

I will show you on the screen a grid with five squares just like those on the front cover of your booklet (refer to booklet). In each square will be a numeral. You will LOOK at the grid for five seconds. Then I will remove the grid and show you a slide with strips of colour on it. You will SAY OUT LOUD the colours you see. You may have time to say only two or three colours. Then I will show a blank slide, and you will WRITE the numerals you can remember IN THE SAME SQUARES on the empty grid on your page. Let's do an example together."

F. Do example "A" with subjects.

"When I show you the grid with the numerals, you must only LOOK at the grid on the screen. DO NOT WRITE ANY NUMERALS IN YOUR BOOKLET.

Now, LOOK (Show trial slide A for 5 seconds)

Now, SAY the colour you see (show filler slide for 2 seconds)

Now, WRITE the numerals you can remember IN THE SAME SQUARES as you saw them. (See page 270 for procedural illustration)

Are there any questions? (Answer as needed)

Now, let's do another sample just to be sure we understand the procedure. Remember I will say LOOK. DO NOT WRITE while the numerals are on the screen. When I show you the slide of colour strips, I will say SAY, and you will say out loud as many colours as you can identify. Then I will show you the blank slide, and say WRITE. Then you will write the numerals you can remember in the SAME SQUARES on your answer sheets.

Do Sample B in same manner as A. Check responses

"Are there any Questions?"

Then begin the actual administration of the test. During these twenty slides there is NO CHECKING BACK! To help focus the children on the task for each slide, the following procedures were used. A stopwatch used to ensure accuracy and consistency of timing.

I:* "LOOK"** (show stimulus grid slide for 5 seconds)

I: "SAY"** (show stimulus filler slide for 2 seconds)

I: "WRITE"** (show blank slide, allow enough time for all to complete)

*I= Investigator

** The appropriate focus word was given during the projector change time for each slide.

,2 Scoring Guidelines

A. The subjects' response grids were hand scored

B. Each grid was compared with a Master Answer Sheet (see page 269).

C. One point was given for each correctly placed numeral

D. The possible total score was 100.

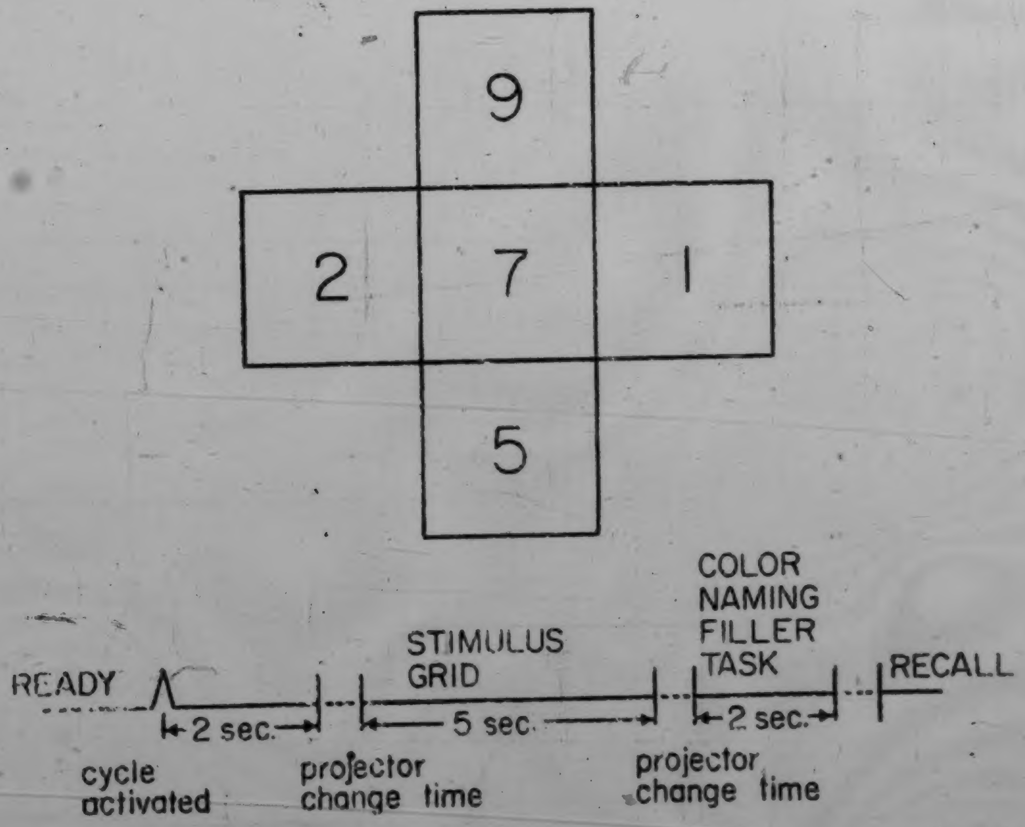
VISUAL SHORT-TERM MEMORY TASK

Example:	Read as:	Example	Read as:
9 8 4 5 1	8 4 5 9 1	9 6 3 1 5	6 3 1 9 5

(1)	2 4 9 7 1	(2)	7 2 3 9 6	(3)	7 5 2 9 4	(4)	4 8 9 3 1
(5)	5 4 8 1 6	(6)	9 7 5 3 1	(7)	3 5 6 1 8	(8)	7 3 9 8 4
(9)	3 8 6 9 4	(10)	5 3 6 1 9	(11)	6 3 2 9 5	(12)	2 3 5 9 6
(13)	8 1 6 5 3	(14)	1 3 5 8 9	(15)	2 4 5 8 1	(16)	8 3 6 5 1
(17)	1 5 6 3 8	(18)	5 9 2 3 6	(19)	4 5 9 2 7	(20)	6 9 2 4 5

.3 Visual Temporal Information Integration (after Leong, 1974)

Visual Short Term Memory Task


9
2
7
1
5
READY
2 sec.
cycle activated
projector change time
STIMULUS GRID
5 sec.
projector change time
COLOR NAMING FILLER TASK
2 sec.
RECALL

APPENDIX B

SIMULTANEOUS SYNTHESIS

(Memory for Design Test)

.1 Administrative Guidelines

.2 Scoring Procedures

.3 Illustrations & Scoring Guidelines for Specific Drawings

SIMULTANEOUS SYNTHESIS

(Memory for Design Test)

.1 Administrative Guidelines

A. Arrange desks prior to administration. Set up slide projector and screen. Check that all is in working order.

B. Seat subjects so each has a clear view of the screen. (Not more than 20 feet from it.)

C. Distribute response booklet with pencils and erasers.

D. Subjects complete identification information on front cover of booklet (Name, Sex, Grade, School, Date.)

E. Number pages from 1 to 15.

F. Give verbal description of task:

"In this task, I will show you a shape on the screen. You will be able to look at the shape for five seconds. Then I will remove the slide with the shape, and you will draw the same shape on your blank page. When you have finished drawing the shape, turn to the next blank page."

Are there any questions? (Answer as required)

When everyone understands the procedures commence the administration of the fifteen design. There is no rechecking for any of the designs. A stop watch was used to ensure accuracy and consistency of timing for each geometric shape.

To focus the children on what they were to do, the following verbal procedures were followed:

1:* "LOOK" (Show stimulus slide with geometric shape for 5 seconds)

I:* (Remove slide) "DRAW."

I:* (When everyone was observed to be finished) "READY!"

I:* "LOOK" (show next stimulus slide for 5 seconds)

Repeat for all 15 stimulus slides.

.2 Scoring Procedures

A. The subject's drawings were qualitatively scored by the investigator.

B. The accompanying scoring guidelines were used.

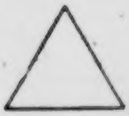
C. Scores were error scores.

D. Total possible errors - 45.

E. Scores were transformed to positive values by adding 50 to each subject's negative error score.

.3 ILLUSTRATIONS & SCORING GUIDELINES FOR SPECIFIC DRAWINGS

1

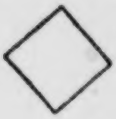


a) three sides - similar length

b) three angles well defined - similar size

c) forms a closed figure

2

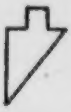


a) four sides - similar length

b) four well defined angles - similar size

c) closed figure must not have kite shape

3



a) extension at top should appear to be one third total height

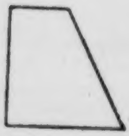
b) top extension should be positioned in the centre of the top horizontal lines

c) left side should appear vertical

d) right side must be diagonal

e) forms a closed figure

4



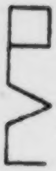
a) top horizontal line should appear to be half of the bottom horizontal line

b) top and bottom lines should appear parallel

c) left side (vertical) and bottom line (horizontal) should appear to be of similar length

d) forms a closed figure

5



a) top section of figure should form a square

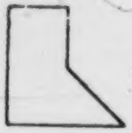
b) top section should appear to be about one fourth of the overall height

c) bottom horizontal line should appear to be same length as side of top square

d) left side vertical lines should appear similar in length

e) diagonal lines forming arrow head oriented to the right

6



a) top horizontal line should appear to be half the length of the bottom horizontal line

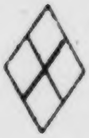
b) left vertical line should appear twice as long as right

c) bottom (horizontal) line and left (vertical) line should appear of similar length

d) acute angle should be right oriented

e) forms a closed figure

7



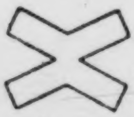
a) height of figure should appear to be greater than width

b) overall figure clearly diamond shaped

c) all internal sections similar size and diamond shaped

d) should appear as one large closed figure made up of four internal closed figures

8



a) figure should be clearly horizontally oriented

b) figure should appear wider than it is high

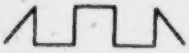
c) top and bottom angles should appear obtuse, side angles must appear acute

d) dour legs of figure should appear of similar length

e) angles at end of legs should approach right angles

f) forms a closed figure

9



a) figure should appear about five times longer than high

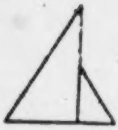
b) all points on horizontal extremities, if joined, should form a straight line

c) end lines should form opposite diagonals

d) one horizontal line on top and two horizontal lines on bottom

e) no closed sections

10



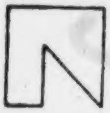
a) middle vertical line and bottom horizontal line should be of similar length

b) the diagonal on the right of the vertical line should join the vertical line about half way up

c) bottom (horizontal) line should be intersected by the middle (vertical) line about two thirds of the distance from the left end

d) two adjacent figures should appear to be right angled triangles

11



a) middle vertical line should appear to be about two thirds the length of the left and right vertical lines

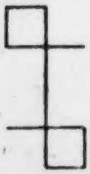
b) bottom horizontal line should be about one third length of top horizontal line

c) if outer lines were extended to insection the figure so formed should be a square

d) overall width and height of figure should be very similar

e) should form closed figure with left section about one third of overall width

12



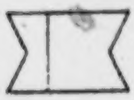
a) top and bottom sections should form squares

b) extending lines must be correctly oriented (top-right; bottom-left)

c) overall figure should appear twice as high as it is wide

d) top and bottom sections should each be about one fourth the overall height

13



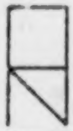
a) overall figure should appear about two thirds as high as it is long

b) left section should be about one third of the total length

c) should form two adjacent closed figures

d) diagonals at either end should meet about mid way on the height of the figure and should be correctly oriented

14



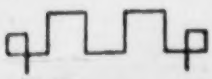
a) overall figure should appear twice as high as it it wide

b) top section should be about one half of total height

c) diagonal must be properly oriented in bottom section

d) if bottom section were closed it too should form a square

15



a) over all figure should appear about five times longer than it is high

b) four vertical lines should appear to be of similar height

c) the two end closed sections should form squares that are about one half as wide and high as the major sections

d) extending lines must be properly oriented

e) if extremities of bottom horizontal lines were joined they would form one straight line

APPENDIX C

NARRATIVE DISCOURSE SELECTIONS USED IN MAJOR STUDY

.1 Scotty Becomes a Hero

- a) Narrative Selection
- b) Parsed Story Units
- c) Story Grammar Analysis
- d) Questions for DQIT

.2 Miss Bella's Plan

- a) Narrative Selection
- b) Parsed Story Units
- c) Story Grammar Analysis
- d) Questions for DQIT

SCOTTY BECOMES A HERO

Scotty was the Brown's pet terrier. Although he couldn't talk, he let everyone know what he wanted. If he wanted outside, he went to the door and barked sharply. When he was hungry, he would go to his dish and bark until someone came to feed him. He even showed his dislike for the neighbour's cat by barking furiously at it whenever it happened to appear. But this barking tonight was too much. It was the middle of the night, and if Scotty kept on, he would waken every member of the Brown family.

"Quiet Scotty," ordered Father from the comfort of his bed. "You can't be hungry, and you were out less than an hour ago. You don't need out right now." Father tried to settle back to sleep, but Scotty kept on barking. Then he bounded up the stairs, raising a terrible racket all the way. Sitting up quickly Father called, "I smell smoke! Get up everyone!"

Mother scrambled out of bed. "Hurry! The house is on fire!"

Father shouted to the children as he rushed into the hall, "Jerry! Cindy! Come quickly! You'll have to stay close to the floor so that the smoke will not choke you. Scotty will lead us out if we follow him."

As the children ran into the hall, Scotty was already on the stairs. Jerry and Cindy followed Scotty down the steps. Their eyes burned with the smoke. It choked them too, and made it very hard to breathe. They could see the flames in the kitchen and in the living room. The floor and the walls were all ablaze. The heat was deadly. Finally they reached the front door. Jerry reached for the door handle. It was very hot, but he finally got it open. They were met by the cold night air as they stumbled onto the lawn.

Bells clanged, and men were shouting orders as three fire engines roared to a stop in front of their house. In minutes they had unwound the hoses, and were spraying the flames with strong steady streams of water. The children huddled together as they watched the firemen trying to save their house. At last the flames were out, and only smoke and steam could be seen coming from the broken windows. A lot of damage had been done to the house, but it could be repaired. The most important thing was that Father, Mother, Jerry, and Cindy were all safe.

Cindy put her arms around the little terrier. "You saved us Scotty."

"You're a brave dog," Jerry added, patting Scotty's head.

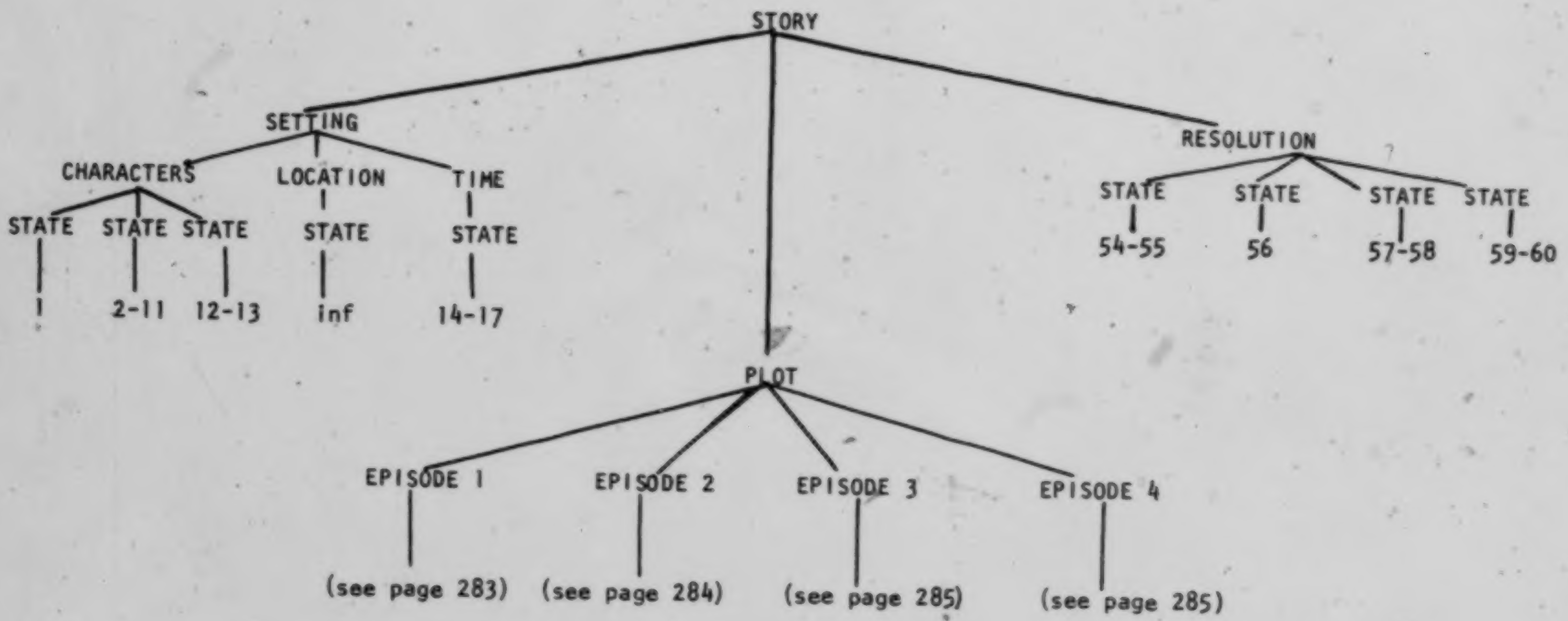
"You can bark as much as you want, any time you want. We owe our lives to you," put in Father.

Story units for: Scotty Becomes a Hero

1. Scotty was the Brown's pet terrier
2. although he couldn't talk
3. he let everyone know
4. what he wanted
5. if he wanted outside
6. he went to the door
7. and barked sharply
8. when he was hungry
9. he would go to his dish
10. and bark
11. until someone came to feed him
12. he even showed his dislike for the neighbour's cat by barking furiously at it
13. whenever it happened to appear
14. but this barking tonight was too much
15. it was the middle of the night
16. and if Scotty kept on
17. he would waken every member of the Brown family
18. "Quiet Scotty," ordered Father from the comfort of his bed
19. "You can't be hungry, and you were out less than an hour ago. You don't need out right now."
20. Father tried to settle back to sleep
21. but Scotty kept on barking
22. Then he bounded up the stairs
23. raising a terrible racket all the way
24. Sitting up quickly, Father called, "I smell smoke! Get up everyone!"
25. Mother scrambled out of bed
26. "Hurry! The house is on fire!"
27. Father shouted to the children
28. as he rushed into the hall
29. "Jerry! Cindy! Come quickly! You'll have to stay close to the floor so that the smoke will not choke you. Scotty will lead us out if we follow him."
30. As the children ran into the hall
31. Scotty was already on the stairs
32. Jerry and Cindy followed Scotty down the steps

33. their eyes burned with smoke
34. it choked them too
35. and made it very hard to breathe
36. they could see the flames in the kitchen and in the living room
37. the floor and the walls were all ablaze
38. the heat was deadly
39. finally they reached the front door
40. Jerry reached for the door handle
41 it was very hot
42. but he finally got it open
43. they were met by the cold night air
44. as they stumbled onto the lawn
45. bells clanged
46. and men were shouting orders
47. as three fire engines roared to a stop in front of their burning house
48. in minutes they had unwound the hoses
49. and were spraying the flames with strong steady streams of water
50. the children huddled together
51. as they watched the firemen trying to save their house
52. at last the flames were out
53. and only smoke and steam could be seen coming from the broken windows
54. a lot of damage had been done to the house
55. but it could be repaired
56. the most important thing was that Father, Mother, Jerry and Cindy were all safe
57. Cindy put her arms around the little terrier
58. "You saved us Scotty."
59. "You're a brave dog Scotty," Jerry added, patting Scotty's head
60. "You can bark as much as you want, any time you want. You saved our lives," put in Father.

STORY SCHEMA FOR: SCOTTY BECOMES A HERO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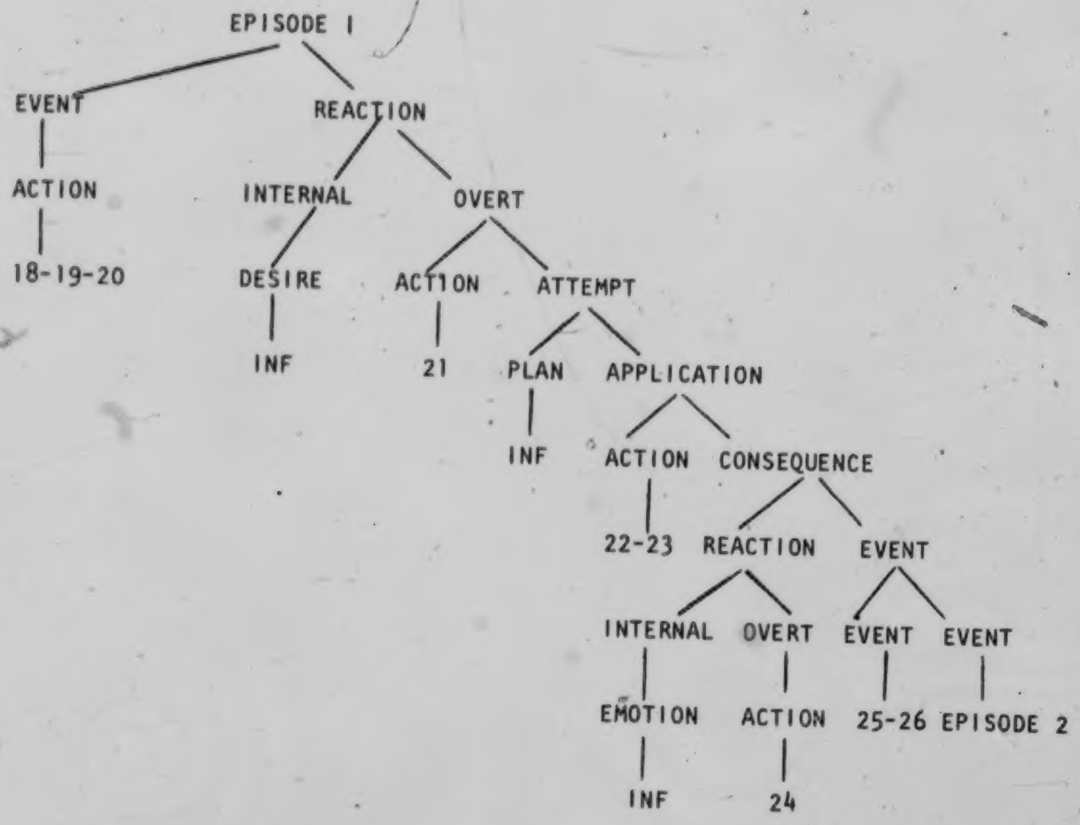
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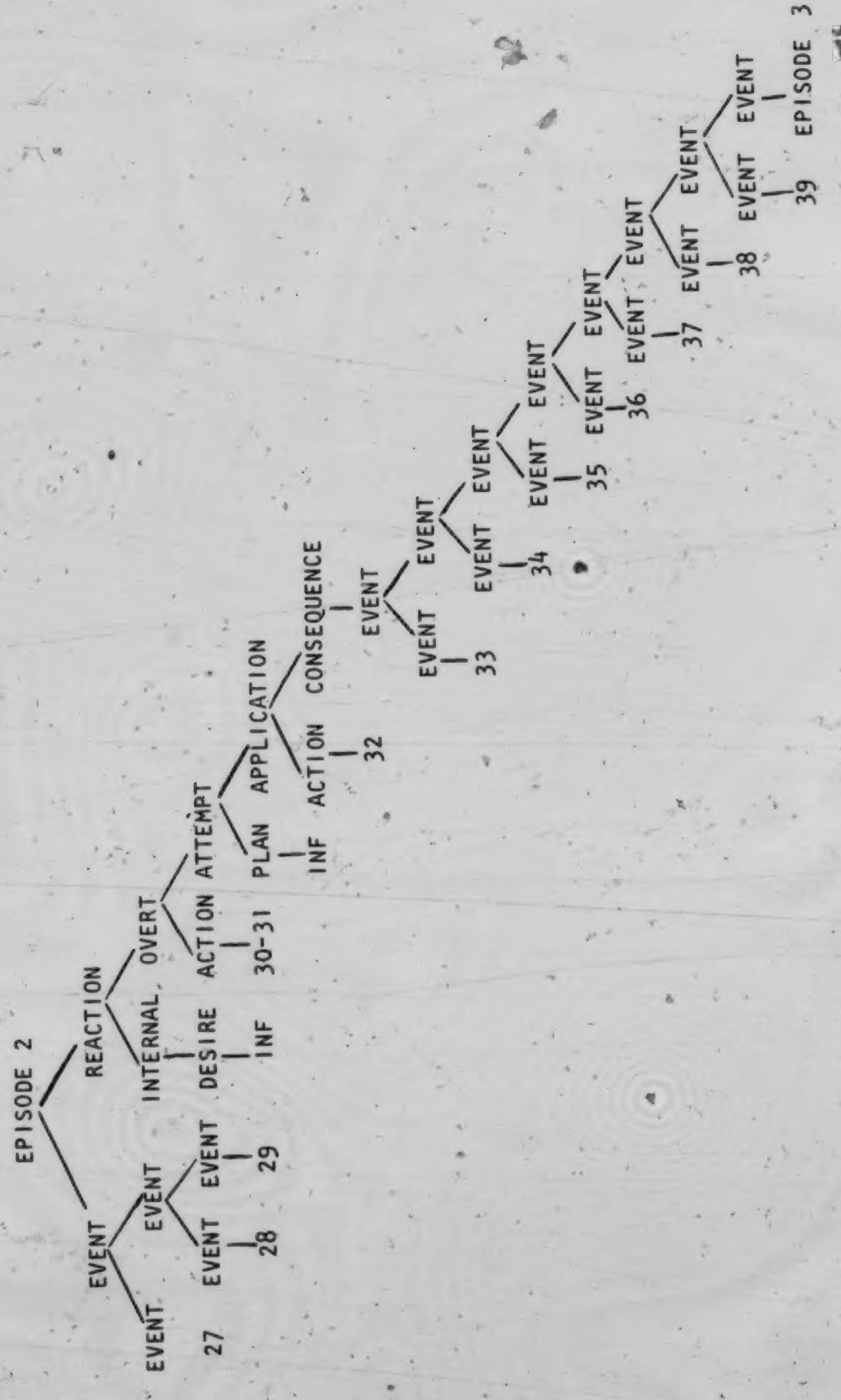
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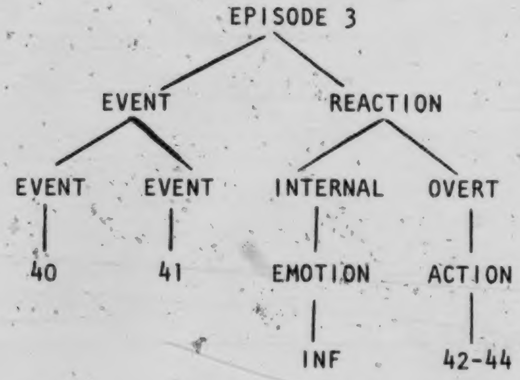
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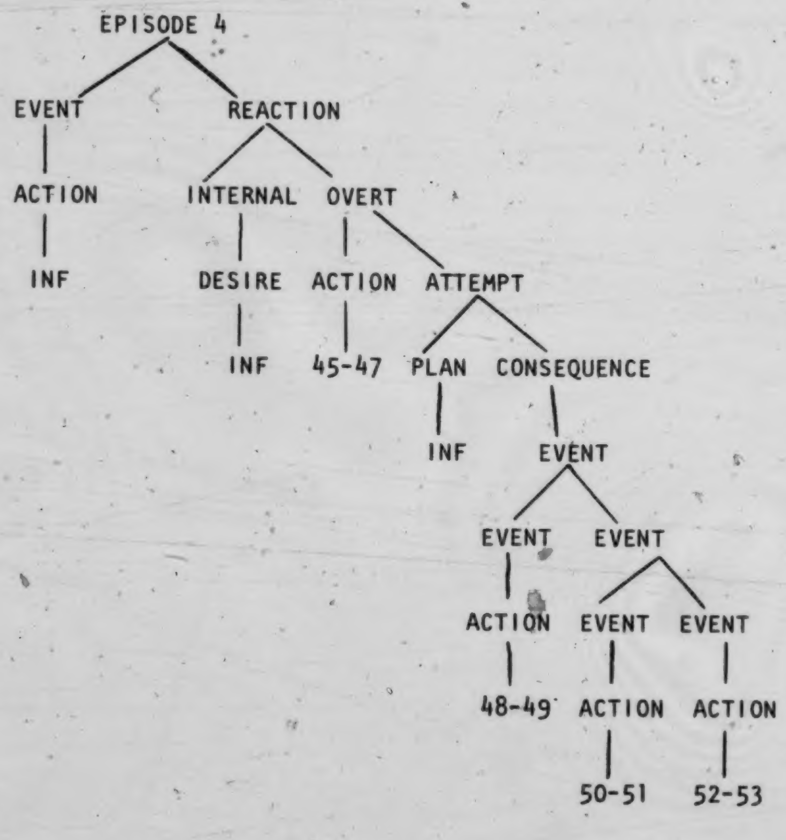
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DIRECTIONAL INFERENCE QUESTIONS
USED WITH
"SCOTTY BECOMES A HERO"

Forward looking Inference Questions:

1. Why did Father not pay attention to Scotty's barking at first?
2. In what kind of community could this story have taken place?
3. Why was Scotty able to lead the children to safety?
4. How long had the fire been burning when Scotty finally awakened Father?
5. Why were the children huddled together on the lawn as they watched the men working?

Backward looking Inference Questions:

6. How did Father feel toward Scotty at the beginning of the story?
7. Where were the bedrooms in the Brown home?
8. Why did Scotty keep on barking even though Father ordered him to be quiet?
9. Why were there three fire engines pulling up in front of the house as the children stumbled onto the lawn?
10. How did Father feel about Scotty's barking at the end of the story?

MISS BELLA'S PLAN

Miss Bella lived by herself in a little white cottage. It was on a small farm by the highway between Riverside and Treesdale. She had lived there ever since she was born, more than seventy years ago.

She was very fond of the wild animals and birds that lived in the woods and fields of her farm. Although her fondness of wild animals was not well known, her kindness toward other people was. Whenever sickness struck one of the homes of the neighbours, Miss Bella was there to help.

The days came when the leaves on the trees changed colour. Then the sounds of shots echoed through the woods on Miss Bella's farm. She shuddered with each report. Which one would be lost today? Would it be the red squirrel, or the brown rabbit? Or would it be the brightly coloured pheasant? She quickly put on her coat and went out to warn away the unwelcome visitors. They certainly had paid no attention at all to the large NO HUNTING signs along her fences.

The next day Miss Bella went to Riverside to shop. Her first stop was the hardware store. "I've decided to take up hunting," she smilingly told the young clerk. She asked to see a shot gun. The barrel shook like a leaf in her old hands. Miss Bella squinted through her thick glasses over the sights. "I've been over to Treesdale, and I've purchased my permit to hunt. All I need now is a gun and some shells. Then I'll be ready to have some fun." The young clerk wiped his forehead with the back of his hand.

The news that Miss Bella had taken up hunting spread quickly to all the local folk. The fellows at the service station told the visiting hunters who stopped for gas about Miss Bella's new interest. "I wouldn't go out to her farm to hunt. She is so near sighted she would shoot anything that moved."

Shortly after Miss Bella bought her gun, she noticed that fewer hunters came to her farm. Still each day she would take the gun, and walk across the field to the woods. There she would fire two or three blasts into the mud bank of the little creek. If she ever saw a visiting hunter, she would squint through her glasses at him. Then she would wave her gun in his direction, as though she had mistaken him for game. Whenever this happened, the hunter was quick to leave.

Finally no hunters came. For the remaining warm days peace and quiet returned to Miss Bella's farm. The birds sang happily overhead as they gathered in flocks, and on the ground the small animals prepared for winter.

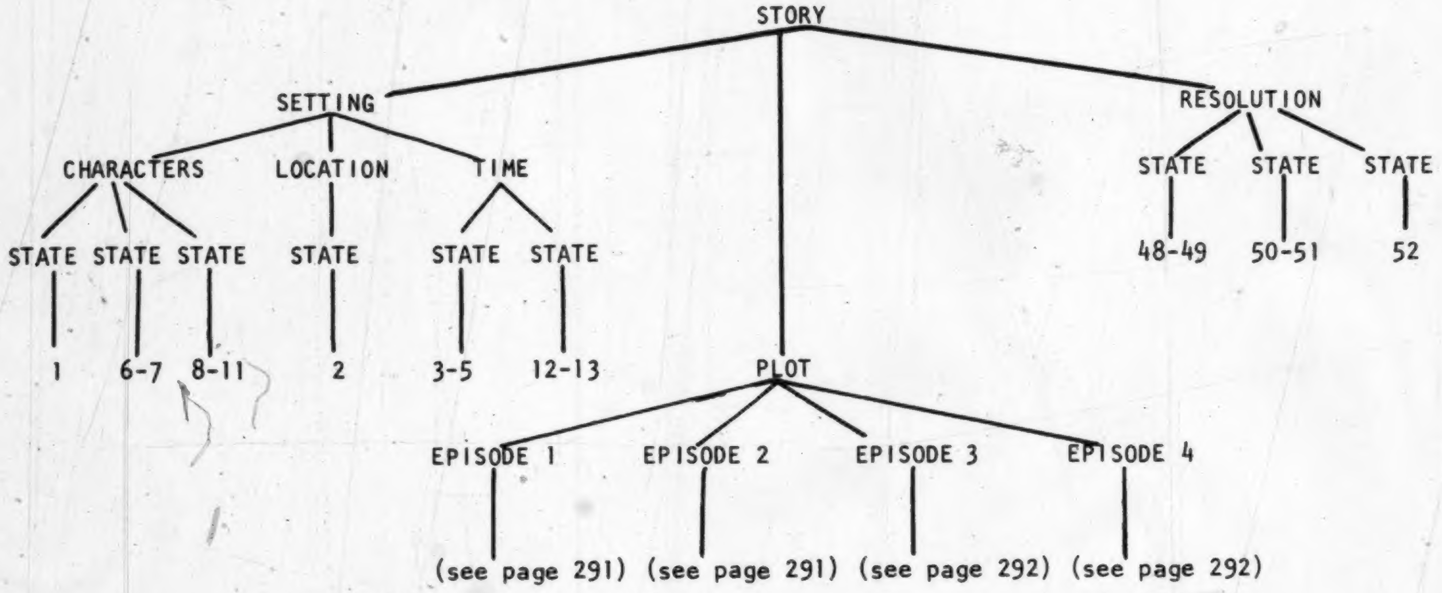
7

Story units for; Miss Bella's Plan

1. Miss Bella lived by herself in a little white cottage
2. It was on a small farm by the highway between Riverside and Treesdale
3. She had lived there
4. ever since she was born
5. more than seventy years ago
6. She was very fond of the wild animals and birds
7. that lived in the woods and the fields of her farm
8. Although her fondness of wild animals was not well known
9. her kindness toward other people was
10. whenever sickness struck one of the houses of the neighbours
11. Miss Bella was there to help
12. The days came
13. when the leaves on the trees changed colour
14. Then the sounds of shots echoed through the woods on Miss Bella's farm
15. she shuddered with each report
16. which one would be lost today
17. would it be the red squirrel
18. or the brown rabbit
19. Or would it be the brightly coloured pheasant
20. She quickly put on her coat
21. and went out to warn away the unwelcome visitors
22. They certainly had paid no attention to all the large NO HUNTING signs along her fence
23. The next day Miss Bella went to Riverside to shop
24. Her first stop was the hardware store
25. "I've decided to take up hunting," she smilingly told the young clerk
26. She asked to see a shotgun
27. The barrel shook like a leaf in her old hands
28. Miss Bella squinted through her thick glasses over the sights
29. "I've been over to Treesdale and I've purchased my permit to hunt. All I need now is a gun and some shells. Then I'll be ready to have some fun."
30. The clerk nervously wiped his forehead with his hand.
31. The news...spread quickly to all the local folk
32. that Miss Bella had taken up hunting
33. The fellows at the service station told the visiting hunters

34. who stopped for gas about Miss Bella's new interest
35. "I wouldn't go out to her farm. She's so near sighted that she would shoot anything that moved."
36. Shortly after Miss Bella bought her gun
37. she noticed
38. that fewer hunters came to her farm
39. Still each day she would take the gun
40. and walk across the fields to the woods
41. There she would fire two or three blasts into the mud bank of the little creek
42. If she ever saw a visiting hunter
43. she would squint through her glasses at him
44. Then she would wave her gun in his direction
45. as though she had mistaken him for game
46. Whenever this happened
47. the hunter was quick to leave
48. Finally no hunters came
49. For the remaining warm days peace and quiet returned to Miss Bella's farm
50. The birds sang happily overhead
51. as they gathered in flocks
52. and on the ground the small animals prepared for winter

STORY SCHEMA FOR: MISSS BELLA'S PLAN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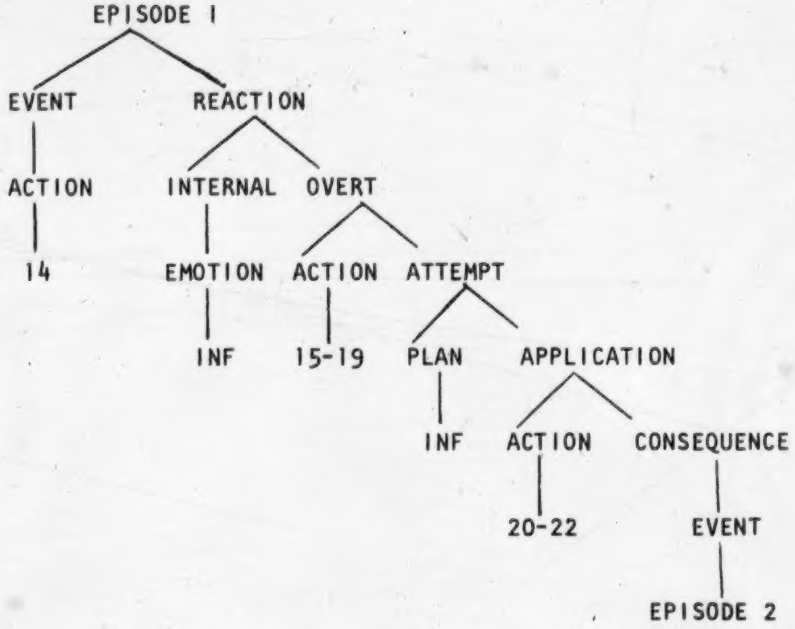
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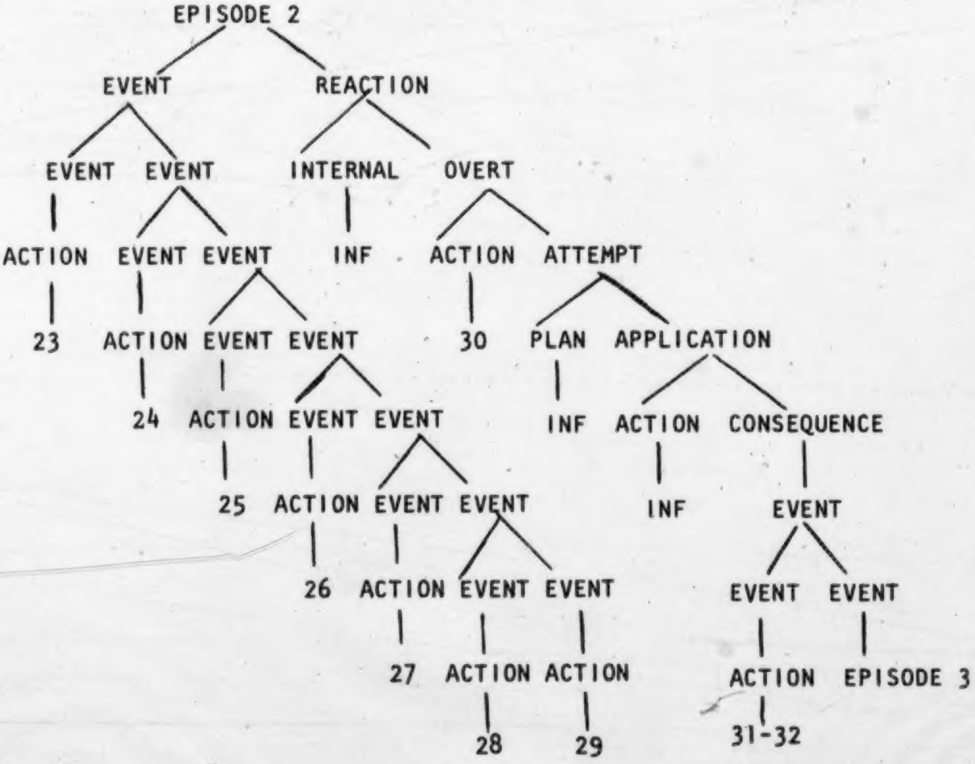
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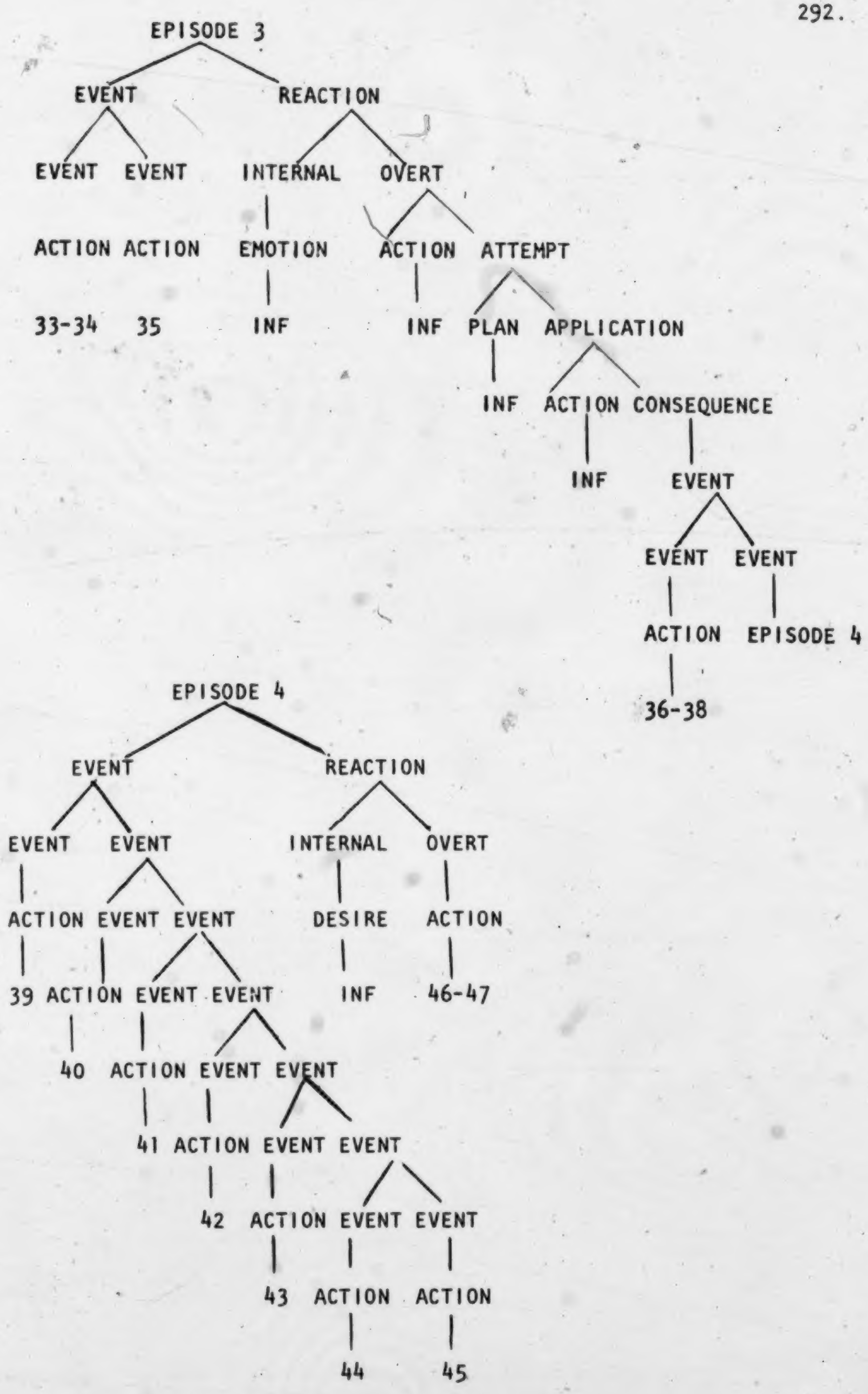
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DIRECTIONAL INFERENCE QUESTIONS
USED WITH
"MISS BELLA'S PLAN"

Forward looking Inference Questions:

1. During what season does this story take place?
2. What kind of a person was Miss Bella?
3. Why did few people know about Miss Bella's fondness of wild animals?
4. Why did the hunters come to Miss Bella's farm to hunt?
5. What kind of transportation did the visiting hunters use to reach Miss Bella's farm?

Backward looking Inference Questions:

6. Where was Miss Bella when she first heard the hunter's gunshots?
7. How did Miss Bella feel when she first heard the hunter's gunshots?
8. Why did the news that Miss Bella had taken up hunting spread quickly to the local folk?
9. Why did Miss Bella go out and fire two or three shots into the bank of the creek each day?
10. How did the young clerk feel when Miss Bella bought her gun and shells?

APPENDIX D

NARRATIVE DISCOURSE SELECTIONS REJECTED ON THE FINDINGS OF THE MAJOR PILOT STUDY

.1 Night Noises

.2 How to Catch a Thief

.3 Making a Decision

.4 Settling in a Free Land

NIGHT NOISES

The Brown Family were spending a week at their cabin at the lake. Mr. and Mrs. Brown had left their two children, John and Janet, and had gone across the lake in their motor boat to visit some friends. This was the first time that John and Janet had been alone at the cabin, and now the sun was setting. They didn't even have their pet dog with them. He was staying with a neighbour in town.

With the coming night a strange silence descended. They had never noticed this kind of silence in town. The noises they heard seemed very different. There were flapping sounds, tapping noises, squeaks, and groans. Some of the croaking frogs sounded extra large. Then the lonely cry of the loon would break through the other noises and echo across the lake. Suddenly the children heard another noise. It was unlike all the others! It was a metal clanging sound. It seemed to come from about where the garbage can was. What could be causing that noise?

Janet grabbed John's arm. Was there some stranger out there? Had he accidentally bumped into the garbage can? It might even be a bear! Again the metal rattling noise broke through the night sounds. John peered out the window into the darkness. "Go get the flashlight, Janet."

Janet returned in a few seconds with the flashlight, and the two opened the door and slowly started out. The rattling came again. They stopped short. It was definitely coming from the garbage can. Slowly they moved forward around the corner of the house. John pointed the light at the can and flashed it on. There was nothing there. "Whatever it was, it has gone," whispered Janet. Suddenly the can rattled again! Janet ran back around the corner quickly followed by John. When John shone the light on the garbage can again, the children laughed at what they saw. Climbing out of the can was a little masked fellow, with a very pointed nose, and a bushy, ringed tail. In his mouth were some scraps of bread. He stared into the light, and then scurried away into the darkness.

"We don't have to be afraid of him," John said bravely. "He just wanted something to eat."

"I'm glad it wasn't a bear," added Janet, as they put the lid back on the garbage can.

HOW TO CATCH A THIEF

The sun was setting in the west. The hill country looked even wilder in the growing darkness. Making his way through the dusk was an old holy man. He had walked all day but was still far from home. He didn't really want to sleep in the strange hills. So he decided to ask at the house ahead for a bed. Upon entering the house, he found a group of five rough men from the hills busy in a game of cards. They were gambling for each other's money. The five wanted to get on with their game. They told the old man he could stay the night in the next room. He thanked them and went straight in and lay down. He soon fell sound asleep.

The card game went on into the late hours of the night. Then a terrible quarrel arose. One of the men had a gold watch, and it was missing. The argument grew louder as the men shouted at each other. This loud noise awakened the old man. He sat up quickly. Quietly he slipped out of bed and went over and opened the door to see what was the matter. Upon seeing him there, the tallest, roughest looking man asked him to help find the villain.

The old man agreed to help to find the thief. "Have you a young dog?" he asked. The tall man nodded his head. "Bring him here," the old man ordered. A small mangy black pup was brought in. Then the old man took the huge cooking pot from off the hearth. He placed the pot over the dog that crouched trembling at his feet. "Now," he said, "when we put out the lamp, each one of you must come and place your hands upon the pot. When the thief does so the dog will bark."

The lamp was put out. In the darkness the men shuffled noisily forward one at a time, and placed his hand upon the pot. "Has everyone done what I said?" asked the old man. The five men answered that each had done so. The task was finished, but the dog had not barked. The arguing broke out again.

"Quiet!" the old man ordered. "Light the lamp and gather around me. All of you must hold out your hands." Each of the five men held out his hands. Four of the men had black dirt on their hands. To the fifth with clean hands, the old man said, "You are the thief. Return the gold watch to its owner."

MAKING A DECISION

Farmer Jones had a fine wheat field. All his neighbours agreed, and a pair of quail thought so, too. They had chosen the middle of the field as the place to build their nest. Just after Mr. Jones had planted the wheat, the quail made a hollow in the ground. There the mother quail had laid her eggs. The young green wheat plants were still quite short when the eggs hatched. As the days of summer had passed, the wheat grew tall and produced golden heads of grain. The baby birds grew bigger and stronger too.

After the young birds had learned to fly, they saw Farmer Jones and his son walking through the grain field. "This wheat is ready to harvest," the farmer said to his son. "Tomorrow I must ask my friends to reap this grain."

The young birds didn't know what to think. They flew quickly back to the nest in the middle of the field to tell their parent. Mother quail was not upset. "There is nothing to fear yet."

The next day came. Mother was right. There was nothing to fear. No one came to cut the grain. But a few days later the young quail saw the farmer and his son in the field again. They flew nearer. "Son, tomorrow we must ask your uncles and cousins to come and help us harvest this grain." The young birds flew straight to their parents with the news. "We will be chopped to pieces if we stay here. Tormorrow the farmer will have his relatives help him cut the grain."

"Don't be frightened by that. As long as the farmer waits for others to help him, we shall be safe," stated the mother.

Again the next morning the young birds found that their mother was right. No one came to harvest the grain. But the next evening the farmer and his son came to the field for the third time. They walked right by the young birds. This time they heard the farmer say, "No one is going to help us with this job. We will have to cut this grain tomorrow by ourselves."

When the young quail returned with this news, Mother said, "It is time for us to move. If the farmer has decided to do his own work, we must leave this very night."

By now the young quail very good at flying. The quail family left the next in the middle of the field and flew to a new home. The next day the farmer and his son cut the grain.

SETTLING IN A FREE LAND

Most early settlers in Canada found that the first few months in the new land were not very easy. This was certainly true for Josh, and his wife Caroline with their five children. They had already had many hardships and adventures on "The Freedom Trail" before they arrived in Canada. Josh was very happy to be free. He was very glad that he and his family had escaped from slavery. But right now he needed a home for his family, and work for himself.

Josh heard that he might be able to get work with a Mr. James who had a farm nearby. The sun was already setting when he arrived at the James home. James shook his head. "This is a bad time to be looking for work. It will soon be winter." Then he added, "Of course I could use some help looking after the cattle, and there will be wood to cut and haul in."

Josh pointed out that he had a wife and five children. "A family!" exclaimed James. "I'm sorry but I haven't any place to keep another family. Unless.....Yes, there is an old shanty out back. It has an attic, too. No one has lived in it for a long time, though.

Through the sagging window Josh looked inside. There seemed to be plenty of room. The roof looked good. The windows and doors were still there. But everything was covered with dirt. The building had been used as a shed for farm animals. "It will do,"said Josh. "May I fix it up?"

First Josh set to work with a shovel and hoe. Then he used a mop and buckets of hot water. Finally he had the room as clean as he could make it. He then built bunks in the far corners. These he filled with straw. Mr. James helped him to repair the fireplace so that it could be used for heat and cooking. Then the farmer brought in two benches, two chairs, and a table. It was very, very late when Josh finally sank down on one of the bunks and fell asleep on the straw.

Josh was up with the sun the next morning. He hurried back to his family. By late evening he and his wife and family had moved into their new home. When Caroline saw that they had a house of their own, she cried. Even the crude bunks, and the rough boards on the floor looked good compared with the slave cabins. They ate their first meal at home in Canada by the light of one small candle. The cheery flames in the fireplace added light and gave warmth to the room.

In a few years Josh owned some cattle of his own. Soon he was able to buy himself his own land. He had learned a good deal from being a pioneer in Canada.

APPENDIX E

EXAMPLE OF SCORED PROTOCOL

.1 Introduction to Interview Session

.2 Instructions for ORIT

.3 ORIT Protocol

.4 SRIT Protocol

.5 DQIT Protocol

SUBJECT #24: INTRODUCTION TO INTERVIEW SESSION

R. What do you like to do after school?

S. Play with my pets.

R. What kind of pets do you have?

S. Cat, dog, and a goldfish and I usually just talk to them.

R. Do they talk back?

S. No.

R. What are some of the things you do with your pets?

S. Well I like to train my dog, kinda, well we play and then sometimes play with a string with my cat.

R. O.K. anything else you like to do?

S. Pay and watch T.V.

R. What kind of things do you like to watch?

S. After school or just anytime?

R. Anytime.

S. Captain and Tennelle, Charlie's Angels, Hardy Boys, Nancy Drew.

R. Do you have a favourite program?

S. Yes

R. Which one?

S. Captain and Tennelle.

R. Why?

S. I don't know, I just like then and I joined their fan club.

R. How did you join the fan club?

S. I got this record "Song of Joy" and it says you can write to these guys and I wrote to them and you can join their fan club.

R. What are some of the things you have to do when you belong to a fan club?

S. Nothing really, like you send them a dollar and then they send you a photograph and stuff like that and you just write back and than and you can draw pictures and send them in and sometimes they show them on the show.

R. O.K. - what do you like to do in school?

S. Music, Math, Reading, Social, I guess everything.

1. In this protocol, R stands for the Reasearcher, and
2. S stands for the Subject.

R. Do you have a favourite subject?

S. Probably Social.

R. Why do you like Social?

S. Cause we're studying about Alberta and it's fun.

R. What are the things you're studying about?

S. Parts of the derrick.
Before we were studying how oil was formed and all that stuff.

R. What other things do you like to do in school, do you have any subjects you like or activities you like?

S. Math.

R. What have you been studying in Math?

S. It's called, I forget what it's called but we're doing multiplying and that and Geometery and now we're doing something called divisibility.

R. How would you rate yourself as a Mathemetician?

S. Pretty good.

INSTRUCTIONS FOR ORIT

R. Has you teacher talked to you about reading between the lines or drawing inferences?

S. Reading between the lines, yeah?

R. You talked about reading between the lines. Well sometimes that's called drawing inferences or making inferences too. When we read we must understand what the author has written. To do this we must read carefully what he has written. Sometimes we must do more than just read what he has written. Sometimes we must use the hints and the facts that the author has given us to add new ideas that help to make the story complete in our minds. When we add this new information which has been based on the facts that the author has given us, then we say that we are making inferences. The activity we're going to do now is related to making inferences. We want to find out how we make inferences, and I'm going to ask you some questions about the story that we read too. Let's do a sample together.

R. Remember we said there were two things that we do:

Read the story and sometimes based on what we read we added in information so we might read--Tommy's mother was in a hurry to get to the store. {[Well, she's in a hurry, so she must need something, right away and if she's going to the store she must be going to buy something.]} Tommy was more interested in talking to the friends he met along the way. {[Tommy must be going to the store with mother] and (there must be friends that live along the street that they are going down.)} He kept stopping to say "hello" to everyone he knew. {Well, if he stops and says "hello" and mother keeps on going he's going to get behind.} Finally he heard his mother call back to him. {If mother had to call back Tommy is behind.} Tommy hurry up, you're as slow as a snail this morning. {[She wants Tommy to come more quickly] [and she's just a little bit upset with him.]} Do you have the idea? (Student nods head). I'd like you to read the story and tell me all the things that you're thinking. Say them out loud. OK., let's try this story.

S. Betty was holding tightly to the strings of a beautiful ballon. {Betty was holding on to a string and there's a balloon there.} Suddenly a gust of wind caught it. {(So she's hanging on to it and really quick a gust of wind like a big breeze, and it kind of like almost like took it away.} The wind carried the balloon up into a tree. {Well then she isn't hanging on to it then (and it goes up into a tree.)} Pop, {the balloon hit a branch.} Pop, Betty cried and cried. {Well the balloon hit a branch (and it popped and Betty was crying) because she loved her balloon.}

R. If I asked you how did Betty feel at the end of the story what would you say?

S. Pretty bad.

R. Why do you think that?

S. Because Betty cried and cried and you'd think, well, you lose a balloon and you're going to feel pretty bad. That happened to me.

R. O.K. Do you think you could tell that story.

S. Word for word?

R. Well you take a look at it and I'll take it away and you tell me the story.

S. Word for word?

R. No. Not word for word, I want you to tell me the story.

S. O.K. Well a girl named Betty was holding on tightly, holding on to the string of a beautiful balloon. Suddenly a gust of wind came and caught it. And it took the ballon up to the branch of a tree. It hit the branch and it popped and Betty cried and cried.

R. O.K. Do you think you can do that with a longer story now?

S. Maybe.

R. This is the story I'd like you to read. I'd like you to do the same thing. Read it out loud and each time you think of something while you're reading you tell me what you're thinking and then when you're finished I'll ask you to tell me the story, and I'll also ask you some questions about it. First of all read it out loud, and anytime you think of something say, it out loud and then keep on reading.

ORIT PROTOCOL

S. Miss Bella lived by herself in a little white cottage. It was on a small farm by the highway between Riverside and Treesdale. {(Well riverthen highway has to go between two towns) or somethin$\overset{F}{\text{g}}$ like that.)} She had lived there ever since she was born. More than 70 years ago. {(So she has to be at least 70 years old.)} She was very fond of wild animals and birds that lived in the woods, and the fields off her farm {(and she really lov$\overset{C}{\text{e}}$d the animals) (and everything.)} Although her fondness of the wild animals was not well known her kindness toward other people was. {(Well she loved $\overset{C}{\text{t}}$he animals) [but $\overset{X}{\text{s}}$he loved the people more,] (kind $\overset{F}{\text{o}}$f like.)} Whenever sickness struck one of the homes of the neighbours Miss Bella was there to help. The days came when the leaves on the trees changed colours, {[that means like it $\overset{C-S}{\text{has}}$ to be Autumn or near there when the leaves change to different colours.]} Then the sounds of shots echoed through the woods on Miss Bella's farm. {[So there's $\overset{C-W}{\text{got}}$ to be some shots someplace.]}

She shuddered with each report, which one would be lost today. {[That means there's^{C-BS} shooting at animals.]} Would it be red squirrel or brown rabbit or would it be a brightly carved pheasant. She quickly put on her coat and went out to warn away the unwelcome visitors. {(So she's going to tell them not to come) (or somethi^{F}ng like that.) [to tell^{x-s} them that there's some danger] (or so^{F}mething.)} They certainly had paid no attention to all the large NO HUNTING signs along her fences. The next day Miss Bella went to Riverside to shop, {[so she's gone to a store $^{c-s}$she has to get something] (or someth^{F}ing like that.)} Her first stop was the hardware store. I've decided to take up hunting she smiled when she told the young clerk, {(so she sa^{c-s}id that she wanted to start hunting, she told the guy.)} She asked to see a shotgun. The barrel shook like leave on her old hands {(so what they^{c-s} mean by a barrel I think is the gun and it just kind of shook.)} Miss Bella squinted through her thick glasses over the sight. I've been over Treesdale and I've purchased a permit to hunt and I need now, all I need now is a gun and some shells, {(some^{c-w} bullets.)} Then I'll be ready to have some fun. The young clerk went to wipe his forehead with the back of his hand. The news that Miss Bella had taken up hunting spread quickly and all the local folk and fellows at the station told the visiting hunters who stopped for gas about Miss Bella's new interest. I wouldn't go out to her farm to hunt. She is so near-sighted she would shoot anything that moved. {(So, like, when she, she's not too good at seeing,) [she might thi^{c-s}nk it's a rabbit] (or something.)} Shorlty after Miss Bella brought her gun, she noticed that fewer hunters came to her farm. Still each day she would take the gun and walk across the field in the woods. There she would fire two or three beasts into a mud bank. {(She^{x-s}'s shootin' them.)} of a little creek. If she saw a visiting hunter that she would squint through her glasses at him, {(her eye^{c}glasses,)} and she would wave her gun in his direction as though she had mistaken him for game, {(for an animal) (or so^{F}mething.)} Whenever this happened the hunter quickly, was quick to leave, finally no hunters came. For the remaining warm days peace and quiet returned to Miss Bella's farm. The birds sang happily overhead as they gathered in flocks, {(in a big $\overset{c}{g}$roup like)} and on the ground small animals prepared for winter, {[like they would go $\overset{c-s}{\text{and get}}$ acorns (and that) to eat]}

R. O.K. Do you want to just take a look at the story, and then I'm going to ask you to tell it it me.

SRIT PROTOCOL

S. There was a lady named Miss Bella and she lives in a little white cottage and she lives there from when she was born and that's over 70 years {(and there's)} she lives by a highway {[which $\overset{x}{s}$eparates two towns]} and she really loves the animals {(and everything) [but she loved $\overset{x}{t}$he people more]} and whenever somebody was sick she was always there to help. {[And when hunti$\overset{c}{n}$g season came]} she would hear all the shots and just shivver {(you know.)} She really loved the animals and she'd put hunting signs up {(and all that)} and but they didn't pay attention {[and she would go an$\overset{c}{d}$ think well I wonder]} which one are they going to get today. Is it going to be the red squirrel, brown rabbit or the brightly-coloured pheasant. So she went out and she went to go to shop. First shop she went to was a gun shop and she told the clerk that she'd taken up shooting and she had her license and all she needed now was a shotgun and some bullets {[so she b$\overset{c}{o}$ught them] (and that)} and when she took the gun at first she was kind of shaky {[and sh$\overset{c}{e}$ went out]} and the news went spread way over town {(and everything)} quite fast {[and they warned her that she w$\overset{x}{a}$s really near-sighted that she might mistake the hunters for game]} and ever since she bought the gun there weren't so many hunters, and then she would go out every day, and whenever she saw something she'd point the gun at a hunter if she thought it was a hunter {(or something)} and so the hunter would quickly leave {[because $\overset{x}{s}$he would think like that,]} and she did this until no hunters came {[and she was^{c} really happy]} and the birds flew over in flocks and squirrels and the animals that lived on the ground would, they went and they got ready for winter. {(They were really happy) (and $\overset{F}{\text{that}}$), (and I $\overset{E}{\text{think}}$ that's all.)}

DQIT PROTOCOL

1. R. O.K. I'm going to give you the story back now. I'm going to ask you some questions. You may need to look at the story to answer some of the questions and if you need to you may do that. During what season does this story take place.

- response 1
- textual support 2
- Verbalized linking 2

S. Probably Fall.

R. Why do you think that?

S. Well hunting season is usually fall and at the end it says that the animals are getting prepared for winter.

R. Is there anything else?

S. The leaves were changing colour.

R. Anything else?

S. Not that I can think of.

R. Did you think it was Fall when you were reading the story?

S. Yes.

2. R. What kind of a person was Miss Bella?

S. Nice.

R. Why do you think she was nice?

1 S. Well she went out and she said that she was going to take up hunting and that but it was kind of just to scare the people

2 away so that they wouldn't come near to hurt the animals there.

R. Why do you think that?

2 S. Well it says that it's kind of like she loved the animals and she also the people and that, and she like tried to protect them.

R. Did you think that when you were reading the story?

S. Unhumm (nodding head).

3. R. Why did few people know about Miss Bella's fondness for wild animals?

S. What was the question again?

R. Why did few people know about Miss Bella's fondness for wild animals?

S. Well, cause she lived in the woods and probably nobody would come to see her.

1 R. Why do you think that?

S. Like if she's way out in the woods she'd probably be mostly alone and probably people wouldn't come out very often.

2 R. Is there anything in the story that makes you think that?

S. Well it just says she's very fond of animals and lives in
2 the woods.

R. Is there anything else?

S. I don't think so.

R. Did you think that very few people came to see her and she lived alone out in the woods when you were reading this story. Do you remember, did you think that?

S. Well, kind of.

R. Or did you just think it when I asked the question.

S. You read something in the beginning, a little part, and then at the end you kind of forget it again. But you kind of remember too. So kind of.

4. R. Why did the hunters come to Miss Bella's farm to hunt?

S. Cause she's out in the woods and the hunters usually go out to the woods.

1 R. What makes you think that they came because she was out in the woods?

1 S. Well, they wouldn't necessarily come to her farm. I don't think they'd shoot on her farm but if she out in the woods
1 then they, you usually hunt out in the woods.

R. Why?

S. Because that's where most of the animals are.

R. Is there anything in the story that makes you think there are animals in the woods?

S. Well, she's very fond of animals and birds and she lives in the woods and that and the birds sang happily overhead and on the ground small animals prepared for winter and usually if you're in the city you usually don't find a squirrel running around getting ready for winter.

R. Did you think that there were quite a few animals out in the

woods on Miss Bella's farm when you read the story?
(answer / yes)

5. R. What kind of transportation did the visiting hunters use to reach Miss Bella's farm?

S. I can't remember too well but I think probably they just walked most of the way.

0 R. Why do you think they walked?

S. Or else they could have rode horses but you can't usually drive a car through the forest.

0 R. How did they get to the farm?

-0 S. Probably on foot.

R. Why do you think that?

S. Or else with a horse or something because usually if you have a whole bunch of woods there's not room for a car.

R. Did you think they came on foot or on horseback when you read the story?

S. Well they must have came somehow.

R. Did you think it the first time you read the story?

S. A little bit.

6. R. Where was Miss Bella when she first heard the hunters gun shot?

S. On her farm.

R. Where on her farm?

1 S. Through the woods on Miss Bella's farm, I don't think it says. Probably in her house working.

0 R. Why do you think she was in her house?

S. She might have been cooking or something like that.

0 R. Is there anything in the story that makes you think she was in her house?

S. No. Probably outside then.

R. Did you think that she was in her house [illegible]u read the story?

S. Yes.

7. R. How did Miss Bella feel when she first heard the hunters gun shot?

S. She shuddered, she didn't like it at all.

1 R. Why do you think that?

S. Well she kind of shuddered and probably she didn't like it because she liked animals and she knew they were shooting them.

R. Did you think that when you were reading the story?

S. Um hum.

8. R. Why did Miss Bella buy a gun and shells?

S. She said she was going to take up hunting but probably because she wanted to scare them away.

R. Why do you think that?

S. Well she said she was going to take up hunting but she wanted to scare them away because she didn't want them shooting the animals or anything.

R. Did you think that when you were reading the story?

S. Yes.

9. R. Why did the news that Miss Bella had taken up hunting spread quickly to the local folk?

S. Because they wanted to warn them and that because she was really nearsighted and if she saw a moose she might think it was some wild animal, and they didn't want anybody getting hurt.

R. How did they find out in the first place?

S. From the clerk.

R. Why do you think that?

S. Like, he was the only one that knew it.

R. Why do you think that?

S. Because she probably didn't tell anyone else she was taking up hunting.

R. Did you think that when you read the story?

S. Yes.

10. R. How did the young clerk feel when Miss Bella bought her gun and shells?

S. Kind of shaky, like.

R. Why do you think that?

S. Well, he could of liked the animals too and but he was feeling kind of funny because she loved the animals and that all along.

2 R. Is there anything in the story that makes you think that?

S. Yes.

R. What?

S. It says decided to take up hunting she smiled and told the young clerk she asked him for a shotgun and the barrel shook like a leaf in her old hands...the young clerk wiped his forehead and the back of his hand.

R. What does that mean?

S. He's kind of thinking - I didn't think she'd ever do that or anything like that. When you're going to do something new like your first day at school - whole thing kind of gets sweaty and that.

R. How do you think he felt then?

S. Kind of funny.

R. What do you mean funny?

S. Well not laughing funny but he didn't really feel guite right cause she loved the animals and everhthing and she goes and says she's going to take up hunting.

R. Have you ever read this story before?

S. No.

R. Have you ever read a story like this before?

S. No I don't think so.

R. Did you like the story.

S. Yes.

R. Why?

S. Well it's kind of like an animal story where somebody's trying to save the animals.

R. Anything else?

S. No. It's out in the country and I'm going to get a farm when I get my Veterinary degree, if I get one, my dad's going to buy me a farm and I get to have horses and that and and he's going to have German Shepherd dogs.

R. That's all we have to do. Thank you very much for coming today and completing these tasks. Let's go back to the classroom now.

APPENDIX F

SUMMARY OF SUBJECTS' PERFORMANCE SCORES ON THE READING-RELATED INFERENCE TASKS ACCORDING TO COGNITIVE SYNTHESIS GROUPS

.1 Low Successive - Low Simultaneous

.2 Low Successive - High Simultaneous

.3 High Successive - Low Simultaneous

.4 High Successive - High Simultaneous

TRANSFORMED PERCENTAGE SCORES

LOW SUCCESSIVE - LOW SIMULTANEOUS
SYNTHESIS GROUP

Subject ID Number	1	2	3	4	5	6	7	8	9	10
Oral-Reading Inference Task										
FLI	76	67	0	75	71	60	92	50	0	75
BLI	24	33	100	25	29	40	8	50	0	25
Accuracy	41	67	100	75	93	100	31	78	0	75
Story-Recall Inference Task										
FLI	30	50	0	0	0	20	80	60	33	50
BLI	70	50	100	100	100	80	20	40	67	50
Accuracy	100	100	100	100	100	100	100	20	60	67
Recall	4	42	20	8	50	48	32	33	15	27
Directional-Question Inference Task										
FLI	48	44	52	32	76	88	24	72	64	48
BLI	84	80	56	60	84	84	40	80	52	48
Response	90	70	70	90	100	100	60	90	90	100
Support	60	65	65	35	65	85	25	70	50	40
Linking	60	55	55	35	65	80	25	65	50	30

TRANSFORMED PERCENTAGE SCORES

HIGH SUCCESSIVE - LOW SIMULTANEOUS
SYNTHESIS GROUP

Subject ID Number	11	12	13	14	15	16	17	18	19	20
Oral-Reading Inference Task										
FLI	53	62	67	50	38	45	62	43	100	0
BLI	47	38	33	50	62	55	38	57	0	100
Accuracy	88	69	92	100	75	82	69	86	100	67
Story-Recall Inference Task										
FLI	38	83	67	33	63	100	100	17	0	20
BLI	62	17	33	67	37	0	0	83	100	80
Accuracy	100	33	78	100	88	100	100	83	50	80
Recall	46	38	33	44	47	25	42	27	21	27
Directional-Question Inference Task										
FLI	92	72	48	68	60	88	72	76	60	20
BLI	84	48	48	76	52	60	72	72	72	44
Response	100	100	100	90	100	100	100	100	70	90
Support	80	50	40	65	40	60	70	65	65	20
Linking	80	50	30	70	50	75	60	70	65	15

TRANSFORMED PERCENTAGE SCORES

LOW SUCCESSIVE - HIGH SIMULTANEOUS
SYNTHESIS GROUP

Subject ID Number	21	22	23	24	25	26	27	28	29	30
Oral-Reading Inference Task										
FLI	70	40	100	57	61	60	40	17	33	100
BLI	30	60	0	43	39	40	60	83	67	0
Accuracy	45	100	100	86	56	70	60	67	100	0
Story-Recall Inference Task										
FLI	57	33	33	37	100	20	75	43	60	50
BLI	43	67	67	63	0	80	25	57	40	50
Accuracy	57	67	67	63	100	80	50	71	20	100
Recall	25	15	40	52	25	33	18	37	19	37
Directional-Question Inference Task										
FLI	48	52	52	72	64	72	28	60	40	52
BLI	36	44	64	60	76	56	36	28	40	56
Response	70	70	80	90	90	100	90	80	80	100
Support	40	45	55	65	65	55	20	35	25	45
Linking	30	40	50	55	65	55	15	30	35	40

TRANSFORMED PERCENTAGE SCORES

HIGH SUCCESSIVE - HIGH SIMULTANEOUS
SYNTHESIS GROUP

Subject ID Number	31	32	33	34	35	36	37	38	39	40
Oral-Reading Inference Task										
FLI	75	86	29	31	70	50	50	30	62	63
BLI	25	14	71	69	30	50	50	70	38	37
Accuracy	100	57	100	92	60	100	100	80	67	75
Story-Recall Inference Task										
FLI	75	67	100	100	25	50	75	33	0	100
BLI	25	33	0	0	75	50	25	67	100	0
Accuracy	100	100	0	75	75	100	75	100	100	50
Recall	72	32	82	35	21	22	21	27	17	30
Directional-Question Inference Task										
FLI	68	76	60	80	60	80	60	76	88	36
BLI	72	82	60	60	36	60	44	64	72	48
Response	100	100	90	100	60	100	60	90	100	90
Support	65	75	55	70	50	60	50	65	80	35
Linking	60	75	50	55	40	65	50	65	70	25

APPENDIX G

INTERCORRELATION COEFFICIENTS FOR SELECTED CRITERION VARIABLES, PERFORMANCE SCORES ON COGNITIVE SYNTHESIS TESTS, AND READING RELATED INFERENCE TASKS

INTERCORRELATION MATRIX FOR FOUR CRITEREON VARIABLES, TWO TYPES OF SYNTHESIS, AND TWELVE DEPENDENT VARIABLES (N=40)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 NVIQ	1.000																	
2 CA	-.266	1.000																
3 VOC	-.010	.023	1.000															
3 COMP	.080	.012	.863+	1.000														
5 SUCC	-.172	-.032	.052	.169	1.000													
6 SIM	.304	-.074	.439+	.515+	-.102	1.000												
7 ORIT-F	-.100	-.121	-.129	.035	.203	-.141	1.000											
8 ORIT-B	.128	-.026	.141	.062	-.154	.250	-.803*	1.000										
9 ORIT-A	.044	-.261	.473+	.472+	-.071	.230	-.117	.427+	1.000									
10 SRIT-F	-.089	.124	.094	.268	.288	.147	.008	.046	-.076	1.000								
11 SRIT-B	.089	-.124	-.094	-.268	-.288	-.147	-.009	-.046	.076	-1.000*	1.000							
12 SRIT-A	-.226	.172	.256	.213	-.141	.155	.044	-.009	-.006	-.321+	.321+	1.000						
13 SRIT-R	.001	.035	.342+	.414+	.179	.050	.066	.047	.292	.296	-.296	-.117	1.000					
14 DQIT-F	-.091	.393+	.566+	.531+	.001	.233	-.025	.007	.265	-.036	.036	.413+	.283	1.000				
15 DQIT-W	.131	.009	.304	.223	-.174	.204	.282	-.240	.184	-.186	.186	.540+	.255	.547+	1.000			
16 DQIT-R	-.022	.209	.227	.224	-.300	.138	-.149	.149	.080	.027	-.027	.394+	.247	.461+	.414+	1.000		
17 DQIT-S	.052	.192	.487+	.451+	.056	.254	.220	-.203	.233	-.096	.096	.468+	.300	.855+	.325+	.362+	1.000	
18 DQIT-L	.013	.225	.529+	.435+	-.099	.250	.134	-.131	.270	-.126	.126	.511+	.227	.870+	.830+	.365+	.929+	1.000

* The high negative correlations between the forward and backward-looking inferences is the result of the percentage transformation procedures.
+ P≤ .05